85th YEAR

AMERICAN GAS JOURNAL

JANUARY 1944

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ROBERTSHAW ON 20 RADIO PROGRAMS COAST TO COAST!

Twenty leading women's service programs over 36 stations in leading range markets from coast to coast are being used by Robertshaw to carry its message to millions of homemakers many times each week.

These programs tell how Robertshaw Oven Heat Controls can aid in wartime fuel and food conservation. At the same time, they are educating homemakers to look for the advantages of Robertshaw Oven Heat Controls when ranges are again available.

Robertshaw

ROBERTSHAW THERMOSTAT COMPANY • YOUNGWOOD, PENNSYLVANIA

JAN 24 1944

INSTRUMENTATION —*The EMCO Way*

Provides accuracy, speed and convenience in measurement by orifice

In addition to manufacturing a great variety of special instruments for use by our Armed Forces, this organization is now handling an accelerated demand for EMCO Orifice Flow Meters and EMCO-McGaughy Integrators. These precision made peace-time products have proven their worth under war induced conditions.

They are being extensively used to provide immediate accurate figures on operating efficiency in synthetic rubber plants, high octane gasoline plants, refineries, magnesium plants, carbon black plants, pipelines and other war vital services.

The combination of EMCO Orifice Meters in the field or plant and the EMCO McGaughy Integrator in the office provides the ultimate in accuracy, speed and convenience in flow measurement by the orifice principle.

THE EMCO-McGAUGHY INTEGRATOR

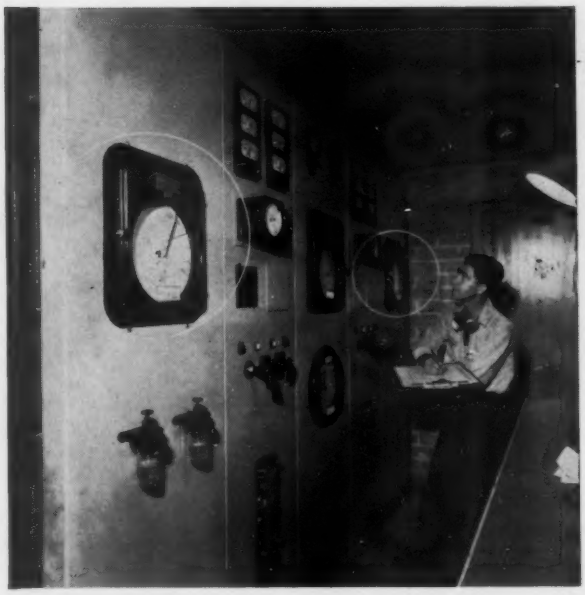
Machine precision in reading flow meter charts of various makes is provided by the Emco-McGaughy Integrator. It automatically reads the total extension of charts and computes in the office, the accurate record that has been made by the meter in the field. It takes the intangibles from flow meter measurement and instills confidence in the results.

One EMCO McGaughy Integrator will do the work of a number of chart readers using the inspection method; read the charts with much greater accuracy and release this personnel for more important war time duties.

EMCO TYPE 38 ORIFICE METER

Due to its rugged construction and simple design, the EMCO Type 38 Orifice Meter requires but a minimum amount of care in the field or plant—an important factor in these days of skilled manpower shortage. Only common, everyday tools are required for routine maintenance.

Of particular importance in the design of this meter is the wide variation in pressure and differential ranges that can be accommodated by the same base instrument. Converting from one range to another is accomplished by simply changing the pressure coil or U tube assembly; an operation which can be done in the field without dismantling the meter from the line.

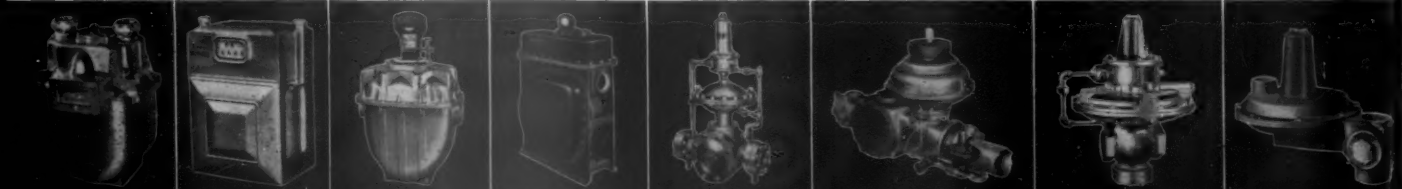


PITTSBURGH EQUITABLE METER COMPANY

Atlanta, Boston, Brooklyn, Buffalo, Chicago, Columbia, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa

Merco Nordstrom Valve Company
Main Offices, Pittsburgh, Pa.
NATIONAL METER DIVISION, Brooklyn, N. Y.

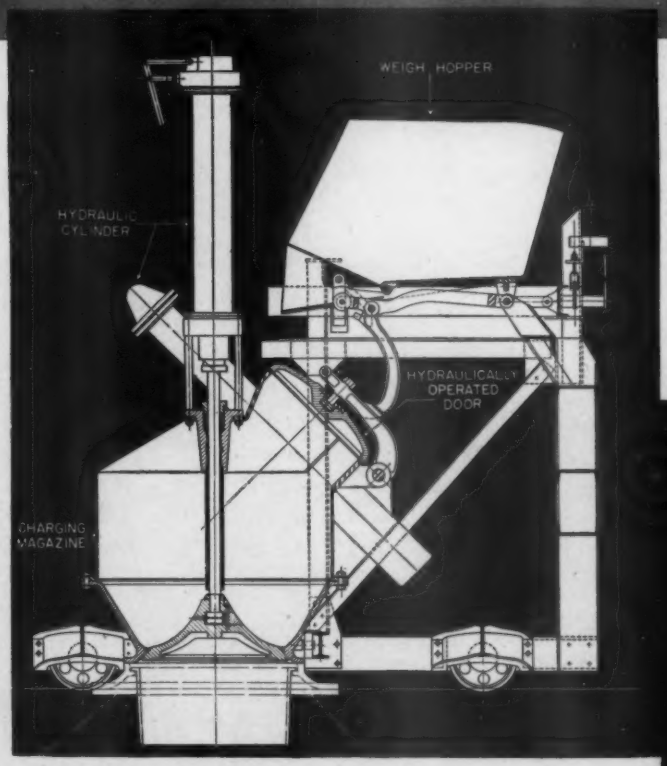
EMCO METERS AND REGULATORS



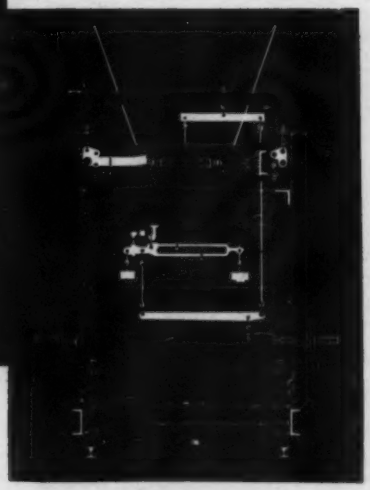
EMCO Standard Domestic Meter | EMCO Tin Meter for Domestic Service | EMCO No. 4 Meter with EMCORECTOR | EMCO Large Capacity Pressed Steel Meter | EMCO Balanced Valve Pilot Loaded Regulator | EMCO Balanced Valve Regulator with EMCOLOADER | EMCO "1001" Regulator Standard Type | EMCO Type "B" Ejector Regulator

For Accurate Gas Measurement and Control

SEMET-SOLVAY *Automatic* CHARGING MACHINE



INCREASES CAPACITY *Saves Labor*



At least ten per cent increase in capacity of your water gas machine can be obtained by the addition of a Semet-Solvay Automatic Charging Machine. Part of the increase is obtained by eliminating shut-downs for charging, part from the added efficiency of a fuel bed of constant depth.

The charger refuels the generator once every cycle during the back-run period. Fuel is accurately weighed by a built-in scale and is uniformly distributed by a hydraulically-controlled spreader. A clamping device gives a gas-tight closure between charger and generator. Seating of the doors is cushioned by the hydraulic cylinders.

The Semet-Solvay Automatic Charging Machine is built for use with any make of water gas or blue gas machine. Automatic charging is not recommended however when the fuel used is bituminous coal. If you operate on coke or anthracite coal, why not write us for further information and a list of satisfied users.

SEMET-SOLVAY ENGINEERING CORPORATION

40 Rector Street — **New York, N. Y.**

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THE NEXT ESSENTIAL

for the "Home of Tomorrow"

SERVEL'S NEW ALL-YEAR GAS AIR CONDITIONER

...ARTS DEVELOPMENT CORPORATION
...609 BROAD STREET . SUMMIT, NEW JERSEY

March 8, 1943.

Servel Incorporated
Evansville, Indiana.

Gentlemen:-

The Servel All Year Air Conditioning Installation has proven most satisfactory. Specifically, the following seemed to stand out in our own observation and from remarks of our friends.

The summer of 1942 was unusually humid in our section of the country. Our friends told us of their troubles with all-dewed rugs and furniture. We experienced no such trouble and credit our good fortune to the 616.5 gallons of water that the Servel unit removed from the air within the house.

From my experience with summer cooled offices, I expected much the same results from the Servel installation. It was a pleasant surprise to find very uniform cooling throughout the house (a room to room check showed a variation of less than two degrees) and an absence of cold blasts of air.

During the first few days of operation we thought we had been "let in for something" from the operating cost angle because the unit seemed to operate so much. But when the season was over, with a total cost of $95.14 including gas, electricity and water, our confidence in human nature was restored. As a matter of fact we feel that next summer we can operate for around $75.00 and still maintain an inside temperature of less than 75° by a little care in the opening and closing of doors and windows. A small cost for the comfort derived from escape from over 95° F. temperatures and humidities of 90%.

Yours very truly

D. C. Hungerford

D. C. HUNGERFORD

DCH:C

Wins enthusiastic praise in 300 test installations

"Couldn't do without it." "Best investment I ever made!" "We point with pride to our good fortune in having this equipment." These are typical comments received from people who helped test Servel's new *All-Year* Gas Air Conditioner.

Three hundred of these installations were made in homes and certain types of commercial buildings throughout the country. Careful records of costs and results were kept, and frank opinions of users secured. In every case the verdict was the same . . . undreamed-of comfort all year round, at a surprisingly reasonable cost!

Servel's new *All-Year* Gas Air Conditioner is the result of nine years' engineering and research. One compact unit performs all six basic air-conditioning functions—cools and dehumidifies in summer, heats and humidifies in winter, provides air circulation and filtering the year round. It combines all the advantages of indirect-fired heating and absorption refrigeration, in one simple-to-operate complete air conditioner.

This new equipment will be available for your post-war clients just as soon as production capacity is released from war work. Write today for the full story about Servel's *All-Year* Gas Air Conditioner. Address: Servel, Inc., Evansville, Ind.

★

SERVEL GAS REFRIGERATORS are standard equipment in the nation's finest apartments.

SERVEL, Inc

America's Leading Makers of Modern Gas Appliances

Another step in *action*

Post-war ~~planning~~

A campaign to influence the men who'll influence the sale of this dramatic new use of gas

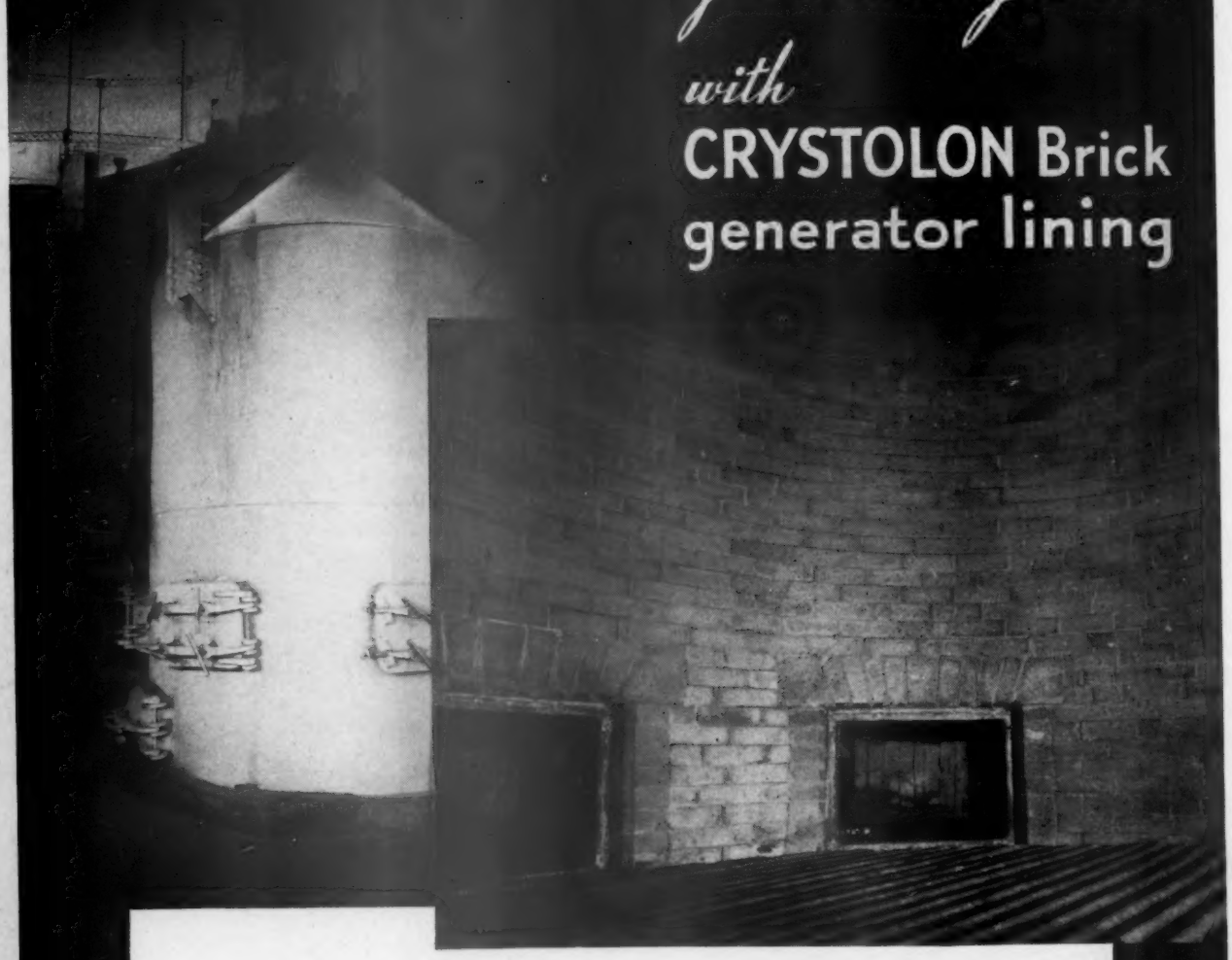
One of the big factors in the post-war sale of *All-Year* Gas Air Conditioning will be the men who will specify and install it—architects . . . heating and piping engineers . . . building contractors . . . realtors. And Servel is beginning right now to reach these men through the best-read business and professional publications in the field.

The advertisements in the opening campaign will tell the dramatic story of this new use of gas . . . paving the way for your own post-war sales plans. And every advertisement—like the one on the opposite page—will be attention-getting, interesting . . . full of the kind of factual, case-study information that will interest this type of reader.

This new campaign offers an effective advertising "backdrop" for *your All-Year* Gas Air Conditioning promotion plans for 1944. Take full advantage of it by contacting all those who'll influence the sale of *All-Year* Gas Air Conditioning in your area. Give them the complete story now, and you'll be well on the road to selling their clients after the war.

Servel, Inc.

OVER 22,000 HOURS *of actual gas-making time with* CRYSTOLON Brick generator lining



"The CRYSTOLON Brick lining was completed in July 1939 and the brick are still in service after 22,362 hours of actual gas-making time up to September 1 of this year, and we expect to operate this set through the coming winter." That is what one production superintendent wrote recently.* CRYSTOLON (silicon carbide) Brick resist slag penetration thus making clinker removal an easy operation, and they both increase plant production and eliminate costly shutdowns for lining repairs.

**Name of plant on request.*

NORTON COMPANY — Worcester 6, Mass.

NORTON Longer Lasting REFRACTORIES

.complete

for every Gas control requirement

REYNOLDS Builds a Regulator for every type of Gas Control Installation. Proved by records of performance in actual operation, or by records of factory tests on new developments, every REYNOLDS unit—whether for high pressure or low—is a proved product.

Long life, efficient operation, accurate regulation, reasonable cost, low upkeep—these are the vitally important inherent features built into REYNOLDS Gas Regulators through more than 50 years of experience in developing, designing, building and testing Gas Control equipment.

Reynolds Products...

- High Pressure Service House Regulators: Straight Lever Type—Models 10-20 Series. Toggle Lever Type—Model 30 Series
- Low Pressure Service or Appliance Regulators
- District Station Regulators, Single or Double Valve, Auxiliary Bowl and Automatic Loading Device Optional
- High Pressure Line Regulators Pilot Loaded—Pilot Controlled
- Toggle Type Regulators. Single Valve, Double Valve, Triple Outlet
- Seals: Dead Weight or Mercury
- Relief Valves: High or Low Pressure
- Back Pressure Valves. Automatic Quick-Closing Anti-Vacuum Valves
- Automatic Shut-off Valves
- Lever Operated Valves
- Louver Operated Device
- Atmospheric Regulators
- Vacuum Regulators

For full cooperation of our Engineering Department, write our Factory, Branch Offices or Representatives.

☆

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Kansas City, Missouri

2nd Unit
Santa Fe Building
Dallas, Texas

☆

REPRESENTATIVES

Eastern Appliance Company
Boston, Massachusetts

Wm. A. Ehlers
No. 268 Park Street
Upper Montclair, N. J.

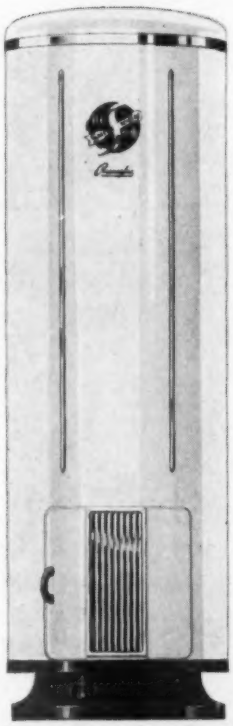
R

REYNOLDS GAS REGULATOR COMPANY

☆ **ANDERSON, INDIANA, U. S. A.** ☆

GAS CONTROL SINCE 1892

SMITHway



YES, the illustration shows a sample of Permaglas—the glass lining of a SMITHway Automatic Water Heater.

You knew Permaglas before the war. You'll know it better than ever when critical materials go back into civilian use.

Permaglas is your hallmark of quality—your basis for selling *profitably* in a market that will demand the highest standards possible in household convenience, sanitation, and cleanliness.

Keep SMITHway Permaglas Automatic Water Heaters at the top of your list. You'll find them a profitable source of customer satisfaction.

***Permaglas** *is the copyrighted name for the glass lining developed and pioneered by the A. O. Smith Corporation for steel tanks. It is corrosion-resistant, smooth, lustrous and sanitary. Its elasticity is equal to that of the steel to which it is fused.*

Heated with Gas . . . Stored in Glass

Permaglas Victory Model Heaters are available in all sizes in accordance with L-185

SMITHway Permaglas
GLASS LINED
WATER HEATERS

Offices at: New York • Pittsburgh • Chicago • Tulsa
Houston • Los Angeles • Seattle

A. O. SMITH Corporation
Milwaukee, Wisconsin

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Photographed by Leon J. Willien

FOR OVER 35 YEARS...

THESE TWO GOVERNORS HAVE SERVED SAN DIEGO

For over 35 years these two Connelly designed and Connelly built 36 inch pipe size governors (the largest size ever built) have been helping control the gas supply of San Diego. Today, with industrial and domestic demands at an all-time high, San Diego has still been able to meet every requirement.

This is not unusual. Connelly governors are aiding Gas Companies throughout the world to meet many unusual pressure demands. They are designed and built to give years of satisfactory, economical, trouble-free service.

For more than 67 years, through wars and peace, Connelly has been supplying the Gas Industry with apparatus and gas purification materials. The vast amount of field data and experience garnered in this time is at the disposal of the industry. Take advantage of this experience . . . consult Connelly . . . there is no obligation.

CONNELLY IRON SPONGE & GOVERNOR CO.
CHICAGO, ILL. ★ ELIZABETH, N. J.

Connelly IRON SPONGE

Again you can get Cast-Iron Pipe

FOR THE

DRESSER BELLMASTER JOINT

Join CIP Faster and Easier with DRESSER BELLMASTERS

Remember in 1941 when the new Dresser Bellmaster Joint—Style 85—was first introduced? Superintendents and maintenance men saw at a glance that here was a faster, better way to join cast-iron pipe. Hundreds sent for a sample joint. Subsequent installation proved its superiority.

Then came the War and cast-iron pipe manufacturers, doing an urgent War job, were unable to change over and expand facilities to furnish the special pipe needed for the Bellmaster. Today, the situation has improved. Makers are now able to deliver Bellmaster pipe. And we are ready to ship these new Dresser mechanical joints promptly in 4", 6", 8", 12" and 16" CIP sizes (about one month for 10" size).

Almost ten million men are at War and manpower is at a premium. This is the opportune time to standardize on the fastest cast-iron pipe joint on the market. It comes in one piece, easy to handle, easy to store. Light, tight, strong, flexible, it offers unfailing service and pipe-line protection to cast-iron pipe users. Investigate the Dresser Bellmaster. Catalog on request.

Dresser Manufacturing Company
Affiliated with Dresser Industries
BRADFORD, PENNA.

1 **WIPE** out spigot end of pipe and inside surface of bell in the usual way.

2 **INSERT** Bellmaster in bell-end of pipe with cap-screws facing out.

3 **TURN** Bellmaster Joint to the right until "lug" hits stop in bell.

4 **STAB** spigot end of pipe into Bellmaster Joint to full depth of bell.

5 **TIGHTEN** screws uniformly with Dresser Bellmaster wrench.

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all INDUSTRIAL SKILLS KEPT. AND *Improved*

These skills have been more than kept alive . . . they have been actually sharpened. Time lags have given way to scientific short-cuts. Materials and machines are being improved and subjected to closer scrutiny.

Industrial skills which formerly went wholly into civilian-use manufactures now are part of the nation's humming War plant.

A momentary glance ahead, to peacetime, reveals a future of better skills, better methods, better products.

AMERICAN METER COMPANY
INCORPORATED (ESTABLISHED 1836)
GENERAL OFFICES • 60 EAST 42ND STREET, NEW YORK 17, N. Y.

2030A

JANUARY
1944

AMERICAN
GAS JOURNAL

VOLUME 160
NO. 1

14,722 Chicago Housewives Contribute To Peoples Gas "Gas Range Survey"

Results indicate accents on practical simplicity, durability, convenience and flexibility.

THE DOMESTIC sales management group of The Peoples Gas Light and Coke Company of Chicago long ago felt that an extensive survey of consumer opinion constituted the first step in planning any post-war customer relations program. On this basic assumption the Company began a survey of customer opinion regarding present-day modern gas ranges together with invited suggestions covering design, construction and utilization changes to meet the needs of homemakers in the post-war period.

The method used was simple, direct and free from Company influence. A 12-page, illustrated booklet entitled, "You Know the Answers—How About Helping Us Out," was presented to Chicago domestic gas users by Company representatives. In this presentation the customer was invited to supply answers to the direct questions and to add comments if he or she felt inclined to do so. It was urged that this be done at the convenience of the customer. After several days the booklets were picked up, and the Statistical Department of Peoples Gas compiled the results.

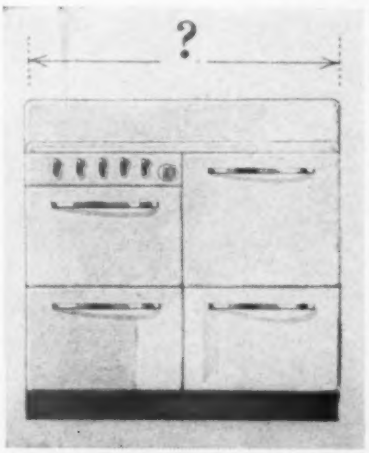
The survey was begun on August 1 and at the present writing (December 1) 14,722 consumer opinions have been collated cumulatively. It should be added that though the survey is being continued for customer contact reasons, future additions to the data obtained will show little, if any, divergence from the results now tabulated and published.

For purposes of convenience to both the customer and the statistical department of the Company, the booklet was divided into the following general sections:

1. **Opinions on overall style for beauty and utility.**
2. **The Oven**
3. **The Broiler**
4. **The Top Burners**
5. **Special Features**
6. **Specific comments and suggestions**

Results Concerning Overall Appeal

The following illustrations show some of the features, far more clearly than words, which the largest number of Chicago housewives feel the post-war gas range should embody. 45% voted for the full table-top model and 26% for its nearest counterpart, the console variation. The two together represent 71% of the entire survey.



WIDTH. Choice indicates as follows: 40 inches 43%, 42 inches 20%, 44 inches 14%, 38 inches 13%, 36 inches 10%.

The lack of appeal for more modernistic designs has caused some surprise. It should be remembered, however, that in the present war period conservatism has been the keynote of present day efficient living. "Flights of fancy" in design give way to "how practical is it and how dependable?" Modernity in design is progressive with time and change and cannot be digested in sudden big chunks. One must be educated to like olives, draped shoulders in men's suits and "boogie woogie."

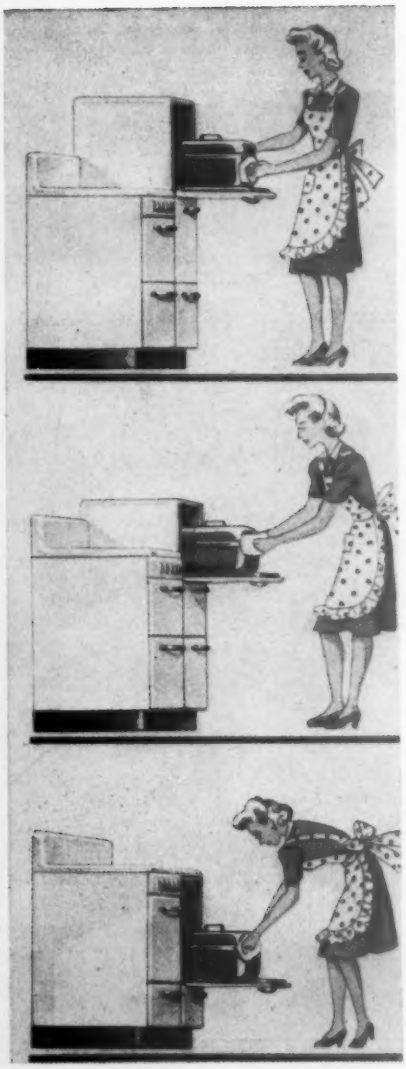
Here is what the poll showed as to the favorite overall width of the modern gas range:

36 inches	**10%**
38 inches	**13%**
40 inches	**43%**
42 inches	**20%**
44 inches	**14%**

Does the modern housewife want her gas range connected flush to the wall? 85% said Yes, while 15% said No.

How about color: 56% voted for an all-white range, 41% preferred white and black, 3% had a personal desire for some other color.

The "white and black" voters for the most part specifically had black cooking tops and the range base in mind. The appearance of cleanli-



THE OVEN. Preference on position shows High 16%, Medium High 37%, Low 47%.

ness, of course, was the motivating influence.

Here are some interesting spontaneous observations by Chicago housewives:

There is a general appeal for materials and design that will permit cleaning to be done even easier than now.

—include a warming compartment for keeping rolls, dishes, etc., at serving temperature.

—almost universal praise is indicated for appearance, no other home equipment has shown such progress in design and construction.

—many housewives feel that condiment sets were designed more for appearance than utility. They also find them to be inaccessible.

—many deplore use of space for storage. Would rather see area used for warming closet, oven, deep well cooker or griddle.

One homemaker wonders whether it is possible to have a combination deep well cooker and top burner.

—another suggests adjustable legs covered by panel. These might be used to level range on uneven floor or to adjust a more comfortable cooking top height.

Now for the Oven

Where do women prefer to have the oven placed in their range? High? Medium? Low? Here are the answers:

(1) Low .....47% (Table top model 36 inches high)
(2) Medium High37% (Higher than table top 48 inches high)
(3) High .....16% (Higher than table top 52 inches high)

20% of all returns indicated an oven size of 14 inches high, 19 inches deep and 16 inches wide. The average of all returns is very close to the majority choice, being 14.9 inches high, 19.3 inches deep and 17 inches wide.

Here is some interesting data on oven window acceptance:

50% voted for front oven window
4% preferred the oven window on top
7% said, "let's have both front and top"
39% felt they would rather do without any oven windows.

As far as "side or middle" location of the oven, tradition seems to exert a strong influence:

Located at side of range, 77%; located in middle of range, 23%.

Here are the unsolicited suggestions covering the oven for the "ultimate" in modern gas ranges:

Why not have a light in the gas oven that turns on automatically when the door is opened?

Let's take the "screech" out of oven racks and broiler pans, is an often repeated suggestion.

To take the "stoop out of cooking" as far as possible, cannot the broiler and the oven be on the same level?

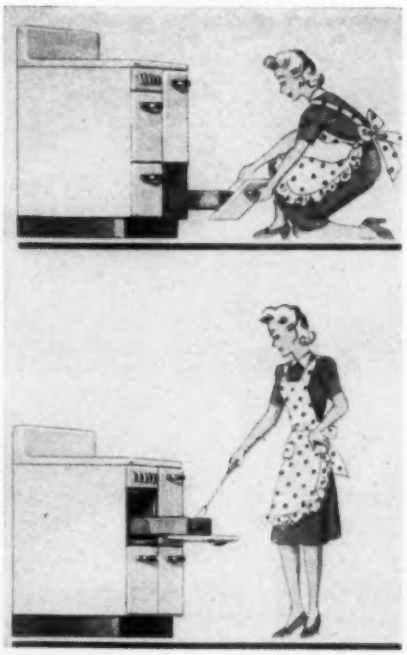
It is often desirable to remove oven linings for a thorough cleaning. Is a one-piece easily removable oven lining an impossibility?

A customer suggested a heat indicator on the outside of the oven. She feels it gives her the same sense of assurance as a thermometer does in a refrigerator. Another customer suggests that the oven burner would be easier to light if the oven burner cock were close by.

The Broiler Data is Analyzed

Shall it be a high broiler or a low broiler? And which is preferable, the drawer type or one that "swings out"? Here are the collected opinions:

77% voted for a high broiler
23% preferred a low broiler
56% felt that the drawer type had definite advantages
44% on the other hand, liked the "swing out" broiler.



THE BROILER. 23% favor the low broiler, 77% prefer the high broiler.

General comments on the broiler include the following interesting items:

How about using roller bearing for broiler rack and drip pan?

Here is a novel idea—a "spit" arrangement for the broiler. The questioner relies on the ingenuity of the gas range designer to make it workable.

Toast and steak require widely different heat intensities and broiling times. The suggestion is for two broiler burners of different heat inputs and heat distribution.

An alert housewife wonders whether a broiler pan could not be built like a turn table. This will make it easier to add and remove broiled foods requiring different broiling times.

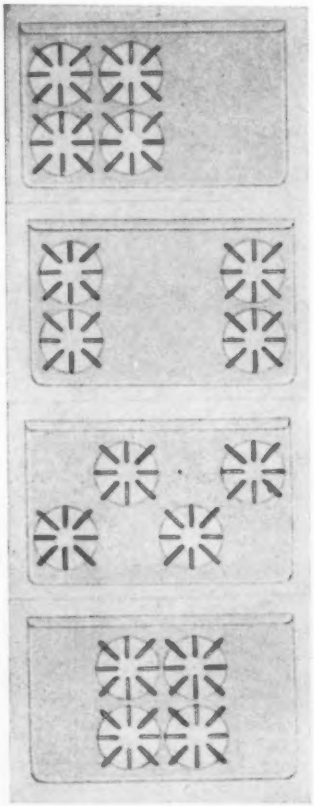
Several customers claim that even the best present broiler burners do not spread heat evenly over the surface of the broiler pans. They wonder if some type of heating element is possible, designed on the same principle as the heating elements in a radiant type Gas heater.

The Cooking Top and Its Burners

"How many top burners do you want on your modern gas range?" was the first question asked.

87% said "four"
10% said "six"

How do upwards of 14,000 housewives want their burners arranged on the cooking top? A glance at the following illustration tells the whole story.



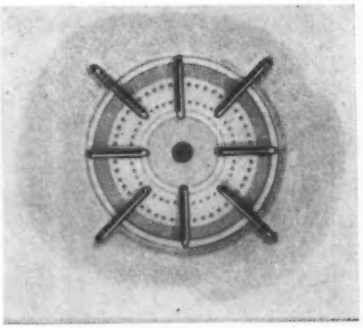
TOP BURNERS. The choice shows as follows: Standard 47%, Divided 23%, Stagger 18%, Center 12%.

The 47% vote for the "standard" arrangement indicates some opinion due to tradition. This is borne out by the relatively high rate of 18% for a "stagger" top, an arrangement that has a fairly recent origin.

A rather difficult question concerned the desired height of the back panel. 35% said 6 inches, 21% felt that 8 inches was better and 44% included variations from 2 inches to 12 inches. It is interesting to note that the average of all falls close to the mean between the two main choices. This average is 6.9 inches.

Cooking Top Accessories

Following is data, presented without comment, on cooking top accessories:



GIANT BURNER. 85% say "yes", 15% say "no."

98% demanded automatic top burner lighting devices.
2% felt they would rather do without.
73% voted for some type of cooking top illumination.
27% felt there was no need for it.
85% wanted a giant burner.
15% preferred all burners of "standard" capacity.
98% asked for simmer speed burners.
2% did not want them.

And here are some of the invited suggestions covering top burners:

"Why not make all top burners 'giant' burners for better heat distribution," says one observing housewife.

Closely associated with this idea is another that suggests the "click" arrangement to indicate a very low flame on the main burners.

Still others observed that the simmer burner "click" provided a too hot and too concentrated heat.

The growing importance of home canning brings the suggestion that there be five top burners on every range—a conventional size in each corner, and an "extra extra" large size burner in the center on which to heat preserving kettles evenly.

"Let's have top burner grids that remain securely in place when wiping the top of the range," is a common appeal.

Many housewives have wondered whether burner cocks and other necessary exposed working parts could be less conspicuous.

A distinctly modern idea was contributed by one customer. "Why not push button control for gas burners" she wondered.

Lastly, here are opinions on "Special Features:"

What type of gas range storage space is most convenient for use? 69% said, "the drawer type." 31% voted for the door type.

Should the modern gas range be equipped with top covers? 73% said "yes"; 27% said "no."

How about time reminders? 92% wanted them; 8% felt they served no important purpose.

Condiment sets as standard equipment resulted in this vote: 72% wanted them, 28% did not wish them.

The poll on the desirability of a deep well cooker as part of the modern gas range inspired this thought provocating result: 48% said, "Yes"; 52% said, "No."

Also indicative of modern trends was the vote on automatic oven lighting: 77% voted in favor of it, 23% felt no necessity for it.

As for oven clock control: 75% wanted it, 25% did not.

Finally: 88% insisted that inside corners be round in future modern gas ranges. 12% voted for square corners.

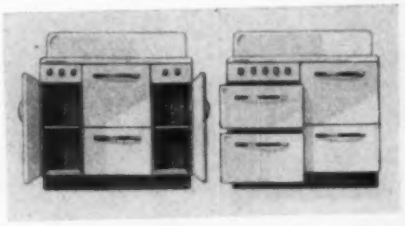
Here are some collateral data:

In the course of the survey every square mile area in Chicago was sampled in ratio to the existing domestic consumers.

Also, wherever possible, the following information was secured:

1. **The apparent economic status of the customer, whether: a—High, b—Low, or c-Medium.**
2. **The estimated age of the housewife.**
3. **The number in the family.**
4. **The type of dwelling occupied, whether: a—A single family residence, b—A 2-flat building or, c—A multiple apartment building.**
5. **The number and type of gas appliances the family use.**

The statistical department of the Company is just completing an exhaustive study of any deviation from the general results of the survey that may be indicated by segregating and collating the returns in the above separate classifications.



STORAGE SPACE. 31% like the door type while 69% prefer the drawer type.

It is safe to say now that there will be no appreciable deviation. In other words, there is a general uniformity of opinion regarding important specifications of the modern gas range whether the customer is rich or poor, young or old, living in a single family residence or a small furnished apartment, whether the family is large or small and irrespective of their degree of acquaintance with other domestic gas appliances.

Modified Equipment to Serve Mixed Gas

By

Paul B. Winchel

Engineer, East Tennessee Light & Power Co.

FOR THE past few years we have been serving straight natural gas, but continued depletion of the available supply has forced us to go to mixed gas.

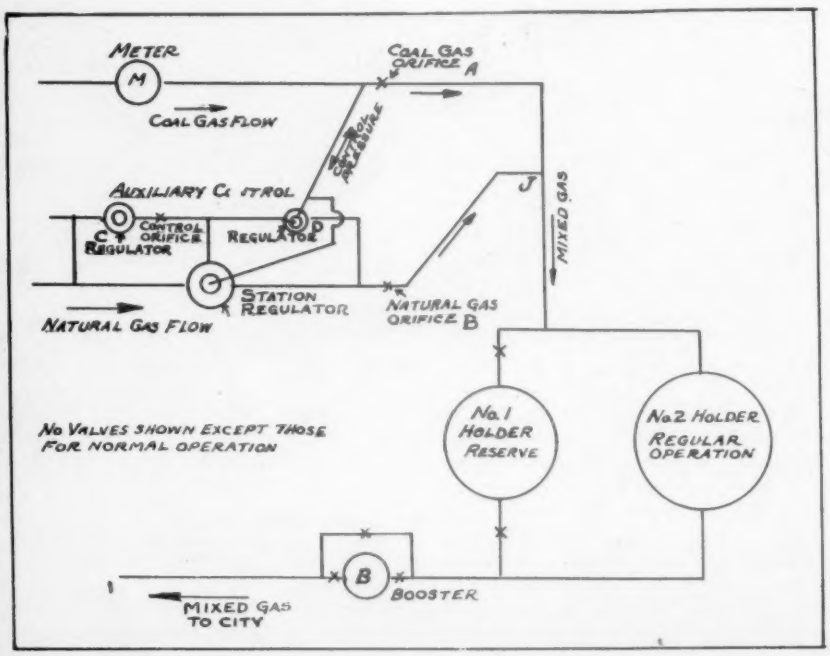
Previous to our adoption of natural gas we were serving straight coal gas made in horizontal retort benches. When it became necessary to mix, our problem was to figure out some practical way in which the two gases could be joined in a mixture of reasonably uniform quality.

Due to the size of our gas property it was uneconomical to install expensive mixing equipment even though it might be available under present conditions and we finally wound up with equipment assembled from what material we had on hand. Results are quite satisfactory.

Our distribution system is all low pressure. Natural gas is delivered to the gas plant at 25 lbs. pressure, where a 6 inch Emco balanced valve regulator reduces it to the final pressure desired for distribution. This regulator operates through auxiliary control, this control being connected to a device which varied the regulator outlet pressure through the day according to the system demand. We decided we could utilize this same control in our mixing operations and a system was worked out according to the schematic diagram shown.

Referring to this diagram, piping was all in place with the exception of the natural gas connection to the holder inlet and the control pressure line. Originally we fed the natural gas directly to the distribution system. However, the mixed gas would have to go through the holder and booster just as the coal gas did under the old operation. Consequently we ran a connection from the station regulator outlet to a point in the holder inlet line where the two gases would meet and mix as they went on to the holder. All regulators shown in the diagram open with downward movements of their diaphragms.

Orifice "A" was put in the coal gas line and orifice "B" in the natural gas line. These were proportioned in size to give the right flow ratio for the mix desired, the size being kept large enough to eliminate excessive back pressure on the coal gas purification equipment. The weights were taken from the station regulator and auxiliary control regulator "D". A pressure line was run from the inlet of coal gas orifice "A" to the top of both auxiliary control regulator "D" and the station regulator. All natural gas coming to the plant goes through the station regulator and all gas made at the plant goes through the meter "M". They meet at junction "J" where they mix and pass on to the holder. As the flow of coal gas increases or decreases the pressure differential at orifice "A" is transmitted through the pressure control line to the top of the station regulator and of regulator "D". Regulator "D" opens or closes as the case may be, and operates the auxiliary control bringing the pressure at natural gas orifice "B" up or down to the same value as at coal gas orifice "A". Any variation in coal gas Btu will level off through the holders and with reasonably good retort house operation there should be no trouble in keeping the mixed gas Btu within reasonable limits. The control is instantly responsive to any variation in speed of the coal gas exhauster. We have a differential manometer at each orifice which gives us a check on the operation of the control.



Due to the fact that we had no room for orifice runs, we just broke flange connections in the piping and installed each orifice at the best place available. This meant that we had to use the cut and try method for determining the final orifice size. However, we are well satisfied with the way the equipment is operating. With orifice runs and regulators having balanced diaphragms and valve mechanisms, the system should operate still better. As it is now, there is a slight variation in differential between orifice "A" and orifice "B", due to the weight of valve and diaphragm. This only amounts to about 2/10 of an inch water column in our case and I did not feel that we should be concerned about it. There is no reason why the system should not work wherever the auxiliary control idea can be employed whether it be on high or low pressure mixing.

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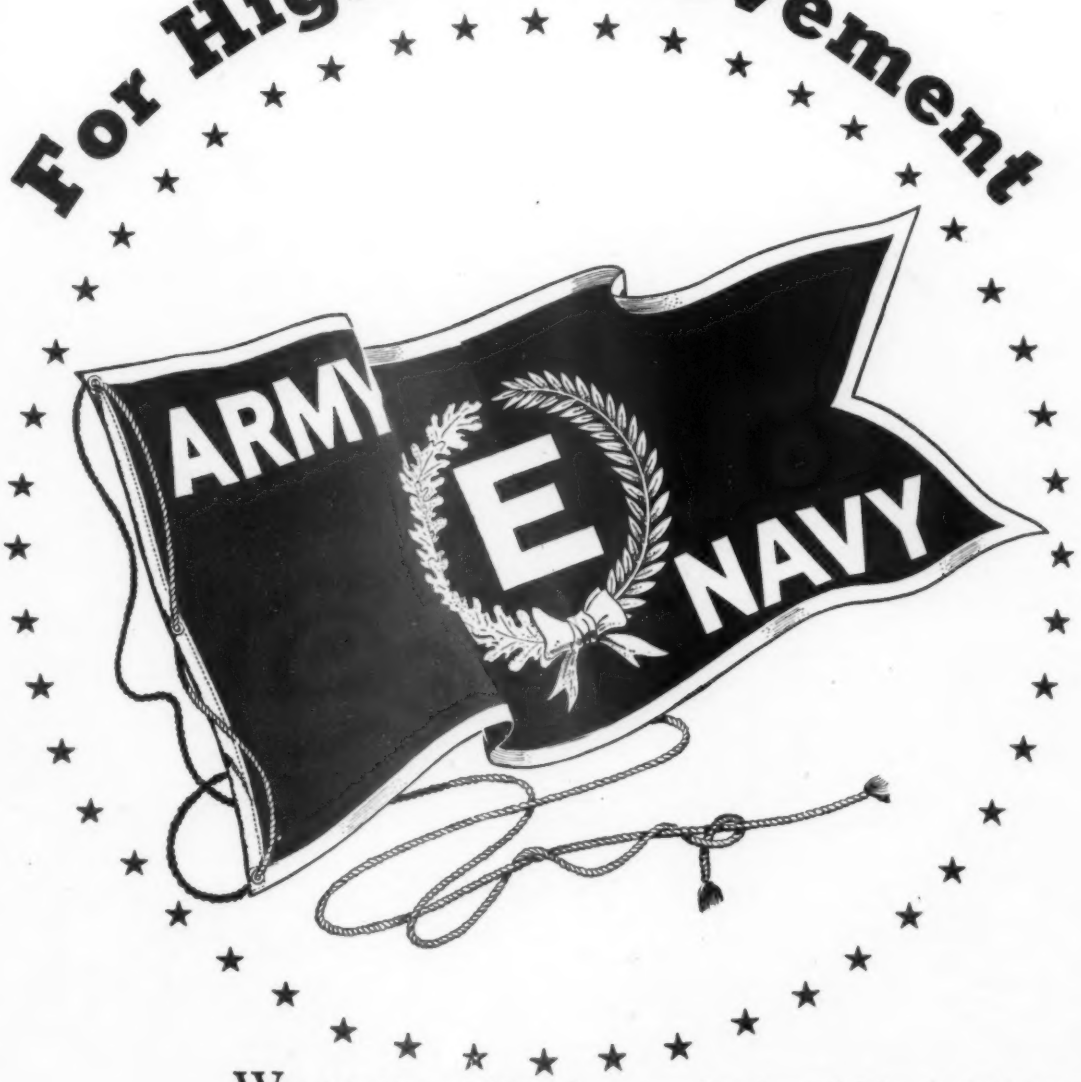

WE of Cribben and Sexton are proud and grateful for the high recognition accorded our war production accomplishments through the award of the coveted Army-Navy "E". . . . . ¶ . . . . . We have striven with all our energies to produce on time, in quality and in quantity the war production tasks assigned us. . . . . ¶ . . . . . This flag to us, is no mere symbol of past accomplishments. It is, instead, an inspiring battle standard to lead us to even greater achievements. . . . . ¶ . . . . . War on the Production front has imposed a driving, imperative and seemingly insatiable demand. We take pride in the fact that Cribben and Sexton together with American Industry as a whole, has met—is meeting,—and will continue to meet that demand on time, and in the quality and quantity needed by our armed forces to insure a decisive and final VICTORY.

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Enclosed Cooling System for Butadiene Plant in Los Angeles

By
Fred A. Herr

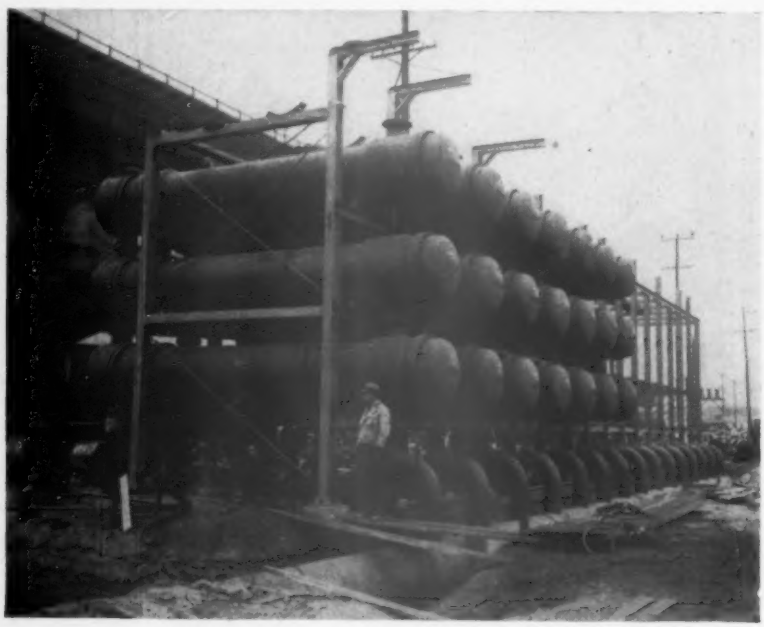
INSTALLATION of a new outside enclosed cooling system at the Southern California Gas Co.'s butadiene plant at Los Angeles to supplement the cooling tower put in during the original construction program in the summer of 1943 was started in November, with completion scheduled for Mid-January, 1944.

The new cooling system, costing approximately $750,000, was decided upon last Fall as a means of eliminating unpleasant fumes which were thrown off during the cooling process, one of the phases of the plant's operation.

The butadiene plant was shut down on November 9 for installation of the new water cooling system and for other repairs and rearrangements.

The new outside cooling system consists of 45 heat exchangers, which were installed by the C. F. Braun Co., which firm had previously designed and erected the absorption unit of the main plant. Installation of 30 of the heat exchangers was completed in mid-December, at which time the plant resumed manufacture on a limited schedule of the synthetic rubber ingredient. The schedule called for the full complement of 45 heat exchangers to be installed by January 15, when the butadiene plant was to be placed on production at its full capacity of 35,000 short tons per year for the first time. Although the plant originally went on production of butadiene last August, its 10 gas generators have never been operated at more than 60% capacity.

Installation of the heat exchangers was directed by J. G. Rollow, construction superintendent of the Southern California Gas Co., under the general supervision of H. L. Masser, executive vice-president. Work on the foundations was started early in November and actual installation of the heat exchangers was begun shortly after plant operations were halted on November 9.



Shown here are part of the 45 heat exchangers of an enclosed cooling system for the Southern California Gas Co.'s Los Angeles butadiene plant on which installation began in November. The program called for 30 units to be in by December 15 and the entire 45 by mid-January. The steel framework for more of the exchangers is visible at the right.

Each unit is 36 inches in diameter, 22 feet long, and contains 20 feet of copper coils through which the gas is passed for cooling.

The new system was installed at a cost of $750,000 to eliminate odorous fumes thrown off when cooling was carried on with the open-air cooling tower visible in the background behind the new heat exchangers.

22 Foot Long Cooling Units

The heat exchangers have been erected in three-high banks adjacent to the existing water cooling tower. Each unit is 36 inches in diameter and 22 feet long. The interior of each unit is fitted with 20 feet of copper coils. The aggregate cooling surface in the 45 units amounts to 196,000 square feet. Operating in series of three, the units are capable of handling 16,000 gallons of oily water per minute and 24,000 gallons per minute of clear water used for cooling.

No provision for an enclosed type cooling system had been made in the original plants. In the butadiene process, naphtha is preheated to 700 Deg. F. in preheaters to crack the naphtha. The gas then is drawn off and passed through scrubbers. The naphtha is forced into the generator, of which the plant contains ten, and superheated steam from the boiler plant is introduced into the top of the generator. The process in the generator proceeds for seven minutes during which the naphtha deposits its butadiene content. Then the steam is shut off, the butadiene withdrawn and the generator put through an eight minute reheating period.

The naphtha, now in vapor form, emerges from the bottom of the generator at 1400 Deg. F. In the process, 2% of the naphtha has become butylene, 3½% butadiene, and 40% has been condensed into liquid light oils which contain the elements of high-octane aviation gasoline. The remainder is residue gas, part of which is available for fuel for the generators or for piping into mains to supplement the company's natural gas supply.

(Continued on page 52)

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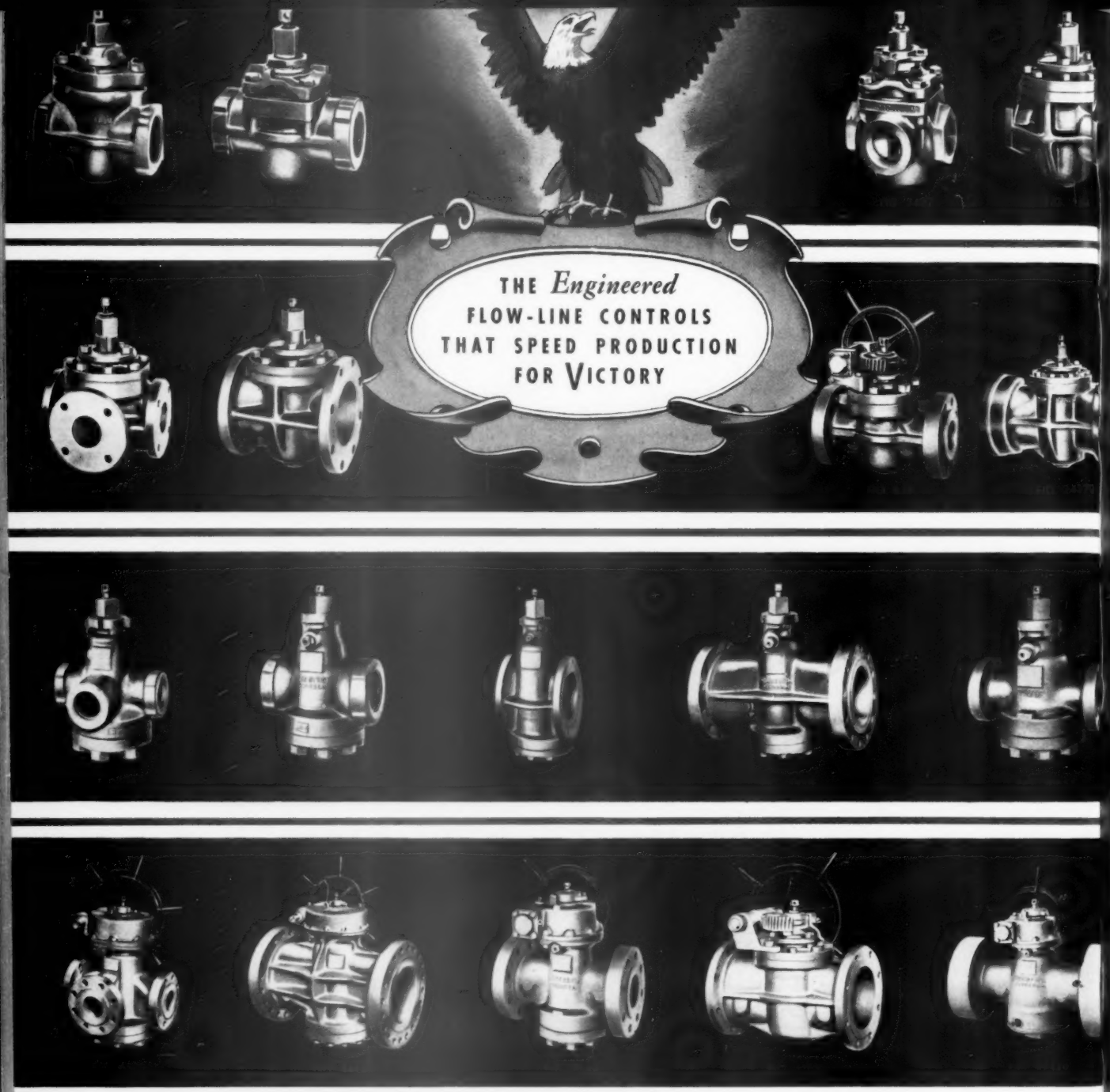

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Highlights of the Gas Utility Industry in 1943

By
Ernest R. Acker
President, American Gas Association
and
President, Central Hudson Gas & Electric Corporation,
Poughkeepsie, N. Y.

DESPITE severe shortages of materials and manpower, the gas industry rates 1943 as a year of marked achievement. While essential civilian services in the home and elsewhere were maintained, facilities were expanded to increase the output of gas fuel needed by industry to meet every requirement of the war emergency without curtailment of supply.

Statistical Summary

At the end of 1943, 19,450,000 customers, the largest number ever connected to the mains of the industry, were being served with gas. This was an increase of 1.9 per cent over the year 1942. Of this total, manufactured and mixed gas companies were serving 10,696,000 customers while 8,754,000 were served by natural gas companies.

Revenues of the entire industry, both manufactured and natural, aggregated $1,071,850,000, an increase of 7.8 per cent over 1942. Natural gas companies grossed $633,195,000, a gain of 8.5 per cent, whereas manufactured gas companies grossed $438,655,000, or 6.8 per cent more than for 1942.

Industrial sales of natural gas registered an increase of 113,558,000,000 cubic feet during the year, bringing total sales for 1943 to 1,019,617,000,000 cubic feet. This was a percentage increase of 12.5. Sales of manufactured gas for industrial purposes were 116,968,000,000, or 24.1 per cent greater than for the previous year.

In the household uses of gas, such as cooking, refrigeration, house heating, water heating, etc., manufactured gas companies sold 303,682,000,000, a gain of 7.1 per cent. Gas consumed for house heating registered an increase of 12.2 per cent. Sales of natural gas for domestic uses registered an increase of 6.1 per cent, or 505,488,000,000 cubic feet.

Indications are that the total production of natural gas in 1943, including amounts used in the manufacture of carbon black and for field purposes, will reach approximately three and one quarter trillion cubic feet. During the year, 294,683,000,000 cubic feet of natural gas were used as fuel for generating electric power. This was an increase of 61,916,000,000 cubic feet, or 26.6 per cent over the preceding year.

Ernest R. Acker

Gas Fuel Conservation

In addition to the question of basic supply, the gas industry has shown an outstanding ability to adjust its operations, personnel and economics to war conditions. It has accepted necessary governmental limitations and restrictions in good faith and has carried its full share for the responsibility of the conservation of critical resources.

The National Seven-Point Conservation Program represents at this time one of the most vital and far-reaching factors in the industry's relationship to the conduct of the war. The initiation of this new program finds the gas industry fully qualified by experience and past performance to give effective support to it.

The oil conservation program undertaken by the industry last winter and during the spring of this year made a substantial contribution to the oil situation and was recognized by governmental agencies as an outstanding industry accomplishment. The approval of the industry's conservation efforts was largely responsible for the avoidance of more drastic alternatives such as the proposed substitution of gasoline for light and heavy oils in water gas production.

Research Laboratories Busy

"More of everything" summarizes the activities of the Testing and Research Laboratories of the American Gas Association during 1943, by far the busiest year in its history, with emphasis placed upon its work in the war field.

Conduct of war work and increased research assignments made it necessary to augment the Laboratories' staff by 125%. Some 14 separate and distinct devices of vital importance to the war effort were developed directly for various branches of the War Department, several of which are in production and others in the test period.

While most of these devices are of a highly confidential nature, it can be revealed that the Laboratories are providing 25,000 automatic oxygen regulators as a safeguard for our flying fighters at high altitudes and an oxygen therapeutic set for the air transport of sick and wounded personnel. Early large-scale production is anticipated on several additional regulating devices developed and supplied for experimental purposes. All these devices are related to the indication, regulation, or detection of gases.

Until the war is won, the greater part of the operations of the Laboratories will undoubtedly continue to be devoted to direct war work. Considerable additional war work is expected, involving equipment developed by the Laboratory staffs.

In addition, the Laboratories are engaged in the most extensive research activities in their history, the program of domestic gas research having been accelerated by 400% in 1943. This is intended to aid in the development and improvement of equipment to be manufactured in the post-war period in order that the public will be supplied with new types

of appliances incorporating the latest features of design and the most effective means of fuel utilization.

For example, such features as complete automatic ignition of all burners, faster radiant broiling, cooler exterior oven surfaces, better visibility in ovens, smaller, lighter and more efficient burners are all well within reach and similar improvements are projected for other gas equipment.

Expansion of the educational, research and library services of the Institute of Gas Technology at Illinois Institute of Technology, brought the annual budget to approximately $200,000. After two years of existence, the Gas Institute now has a fellowship group of 21 post-graduate students training for specialized technical service in the gas industry. There are in addition, a number of research projects underway for various gas utility companies as well as several long-range fundamental research programs established for the general benefit of the gas industry at large.

Natural Gas Expands

Evidencing a solid front in support of the war program, this branch of the industry has demonstrated that it is sufficiently flexible to meet requirements of a growing market despite a multiplicity of shortages in both men and materials.

The essential needs of eight and three quarter million homes and business establishments were met, together with a substantial portion of the gas fuel requirements of almost two million additional customers who use mixed gas. An ever-increasing quantity of natural gas was furnished for use in war manufacturing processes—up to perhaps 70% of the total volume of natural gas delivered during the year to customers, exclusive of field use.

Many pipe line companies selling gas to large volume consumers on an interruptible basis increased their annual output without the use of new critical materials in any substantial quantity.

During the year the need of additional transmission facilities resulted in Washington approval of the construction of several important lines. These include 120 miles of 20-inch line of The East Ohio Gas Company which will supplement with 50,000,000 cubic feet a day the supply available to the congested centers of the Cleveland area and the Cities Service Transportation and Chemical Company line of 231 miles of 26-inch pipe which will increase supplies in Kansas and Missouri.

In addition, authorization has been given to the Tennessee Gas & Transmission Company to build 1200 miles of line from Driscoll, Texas to West Virginia. This increase in supply will be of tremendous advantage to the Appalachian area whose local supplies have been strained because of the unprecedented demand in that region by war industries and by domestic customers having a priority status.

War-time evolution of the use of natural gas hydrocarbons in industries that are clearly separate and apart from the production, transmission and distribution of natural gas for fuel uses, holds out great promise for the future.

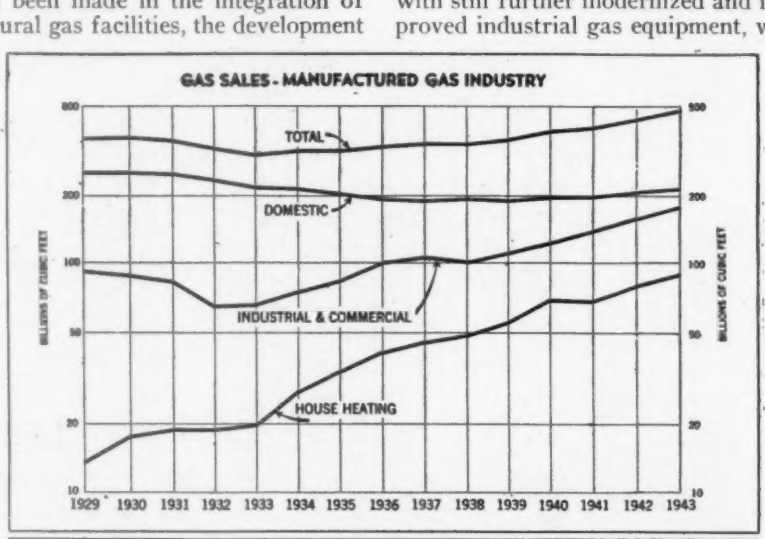
Skilled research chemists have shown that it is possible to rearrange the molecular structure of natural gas hydrocarbons in a multitude of new ways and bring forth dozens of end products that include a variety of solvents, plastics, explosives, synthetic rubber and aviation gasoline.

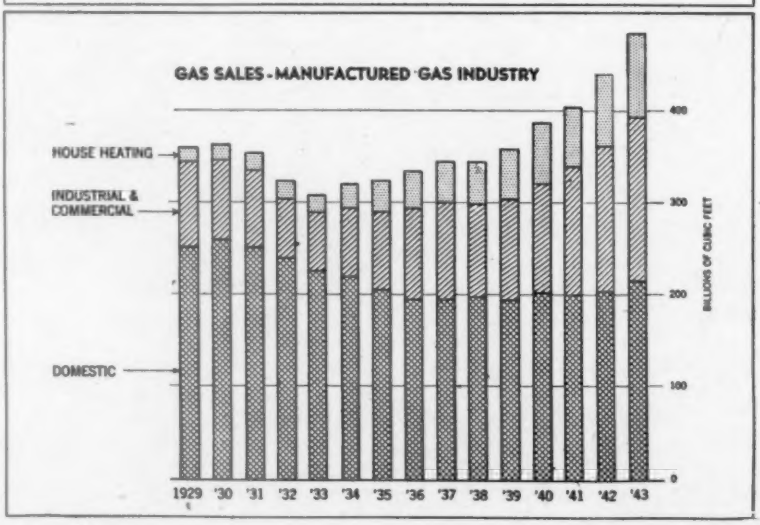
During the year notable advance has been made in the integration of natural gas facilities, the development of underground storage and the liquefaction of natural gas to provide increased storage in a minimum of space against winter peaks.

Industrial Gas

Although the war production program launched the greatest industrial heating revolution ever experienced, the peak of factory expansion and new factory construction required by the gas industry was passed in 1943, and the program nears completion. Unprecedented quantities of modern, efficient, industrial gas equipment were installed during this period, and older gas equipment was revamped in order to turn out new war products. Upon these industrial gas furnaces, ovens and other apparatus depends the superior quality of the vitally important parts of practically every implement of war fabricated in the United States.

The industrial gas loads that keep these war furnaces running day and night are the largest ever provided by the gas industry and, together with still further modernized and improved industrial gas equipment, will


GAS SALES - MANUFACTURED GAS INDUSTRY
TOTAL
DOMESTIC
INDUSTRIAL & COMMERCIAL
HOUSE HEATING
BILLIONS OF CUBIC FEET
1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943


GAS SALES - MANUFACTURED GAS INDUSTRY
HOUSE HEATING
INDUSTRIAL & COMMERCIAL
DOMESTIC
BILLIONS OF CUBIC FEET
1929 '30 '31 '32 '33 '34 '35 '36 '37 '38 '39 '40 '41 '42 '43

be the foundation for large and important industrial gas loads after the war.

Probably the most significant progress of the year was made in radiant gas heat and its application to baking, curing and drying operations. The brightest future in processing appears to be opening up to methods which permit more rapid heat transfer, reduction in space for equipment, more precision in control, and a reduction in capital investment in equipment—promising ever-widening usefulness for radiant gas burners. This gives gas a lead position in the realm of chemistry and plastics; there are great possibilities in the food dehydration industry, in textiles, in steel, ceramics and in china. Today, radiant gas-fired heat-treating furnaces and china-firing kilns are being operated at temperatures of 2400 degrees F.

The gas used for radiant combustion may be in any of the commercial forms — natural, manufactured, mixed, or liquefied petroleum gases, but the burners must be designed both for the particular type of gas, as well as for the particular application.

Illustrative of the flexibility of gas fuel is the unique application of natural gas in the production of magnesium, because of the opposite role it plays; it is used in the carbothermic processes as a shock chilling agent, bringing the temperature down to 395 degrees F.; and it is used in the ferrosilicon processes as a fuel to produce furnace temperatures of 2000 degrees F. upwards.

Several large plants in this country are utilizing these processes to produce the huge quantities of magnesium needed in airplane construction and in the production of supplies for the Ordnance Department.

Commercial Field

Immense quantities of new gas equipment were installed in 1943 for the purpose of feeding the Army, Navy and the Marines in their training period and in most of the permanent stations and bases at home. In addition, the great increase in meals eaten by war workers was, in most cases, taken care of with gas equipment.

Also, the upsurge in general civilian "eating out" — superinduced by the high points required for rationed meats and canned foods, taxed the capacity and durability of the gas equipment installed in hotels, restaurants, lunchrooms, night clubs and other eating places.

Home Service Contributes

Home service, the branch of the gas industry which represents the largest group of graduate home economists in a single industry in the world, is credited with making the year's major contribution of the industry to community life and national welfare under wartime conditions.

Complete cooperation and aid was given the governmental programs of nutrition in the home and in industry, conservation of foods, fuels and appliances, and the establishment of information bureaus to interpret and "sell" food rationing to the public. To this end, 12 million customer contacts were made by home service personnel within the year as a means of the government's requisite wartime programs on the Home Front.

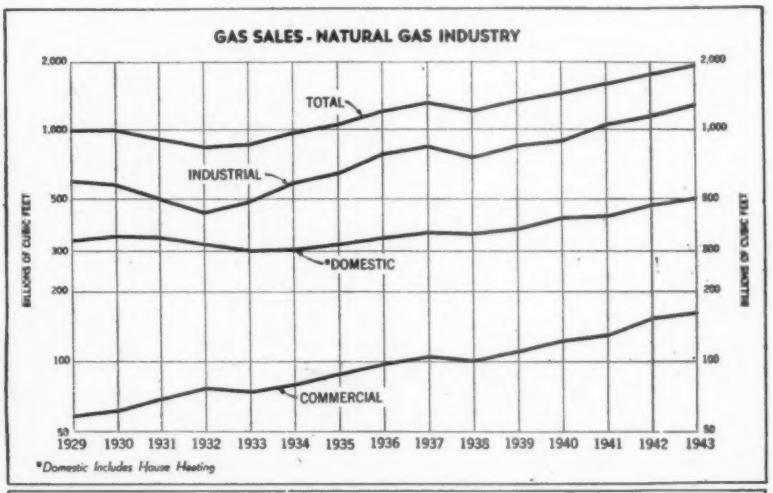
Post-War Plans

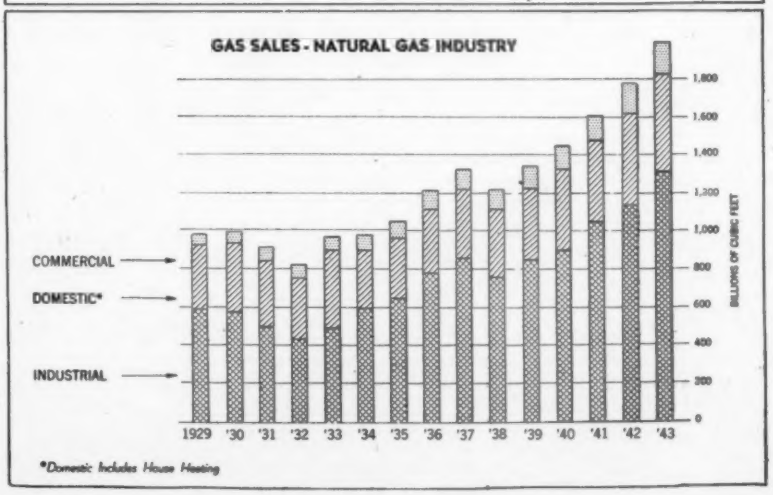
Since it is granted generally that the transition from war to peace will be a difficult and complex period, plans are being made for the reconversion of the gas industry to a sound peacetime economy with the cessation of war, in order to reduce dislocations to a minimum, stabilize the industry through the period and have tested and approved household appliances ready for production as soon as factories can be reconverted.

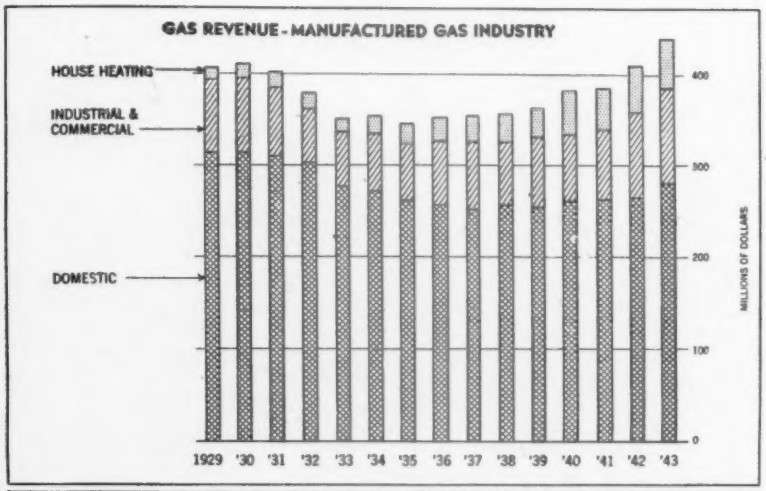
Factors being appraised include character, scope, and methods of expanding markets, changes in purchasing power, development of new appliances and preparation for the resumption of sales activities.

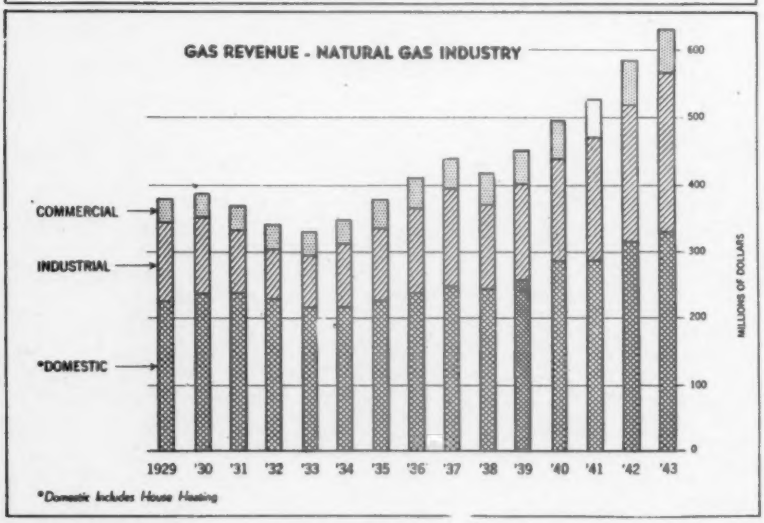
The industry believes there are many fundamentals as to why it can best serve the domestic market; the quality of service rendered to the customer; the conservation of national resources; employment of labor; basic economics to the customer and to the company.

In appliances, the industry has ceased to think in terms of ranges, water heaters, and house heating equipment as separate units, but rather of the combined service where each appliance becomes a sustainer of the other and the benefits of added loads may reduce the cost to the customer. This fact makes house heating assume new importance, especially since one of the most promising of new services which will be avail-





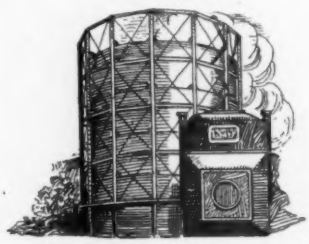




able is year-round air-conditioning. This has passed the field test, awaits the go signal for production, and is expected to provide a substantial addition to the industry's off-peak load.

An effort was made during the year to seek to reduce to a minimum the number of domestic gas appliance models required, as well as individual company requirements to the end that the equipment suppliers might reduce to a minimum their costs of manufacture, and thus be able to provide high quality equipment to insure maximum customer satisfaction and at the same time at minimum cost.

Among other plans, there is in process of evolution a coordinated kitchen equipment plan which the gas industry can offer the public as a complete package kitchen, including cupboards, sink, range, refrigerator, dish washer, water heater, etc. This can be purchased piecemeal or all at one time, and the plan already has the support of some large kitchen equipment manufacturers and some important national sales outlets.



New England Gas Assn. Committees Consider Post-War Plans

THE BOARD of Directors of The New England Gas Association approved the reports of three Association committees at their last meeting (on December 3, 1943), the committees having been at work since the start of the Association's year on April 1.

One report was that of the Appliance Study Committee whose chairman is Roy E. Wright, director of gas sales, New England Gas and Electric System, and chairman of the NEGA Sales Division. Another report was that of the Kitchen Heating Committee whose chairman is J. J. Quinn, general sales manager, Boston Consolidated Gas Company, and a past president of NEGA. The other report was that of the Economic Survey Committee whose chairman is James A. Cook, general manager, Lynn Gas & Electric Company.

The Appliance Study Committee presented its ideas concerning improvements which seemed desirable for use in post-war gas ranges. This committee will later present other reports to the NEGA directors covering water heaters, refrigerators, house heaters, and commercial equipment. The range report contained ideas divided as follows: Construction—17; burners—15; ovens—7; controls—7; general—7; broilers—5; doors—4; pilot ignitions—4; flues—2; grates—2.

A feature of this committee's work was the preparation of a detailed customer survey regarding post-war gas ranges by a subcommittee whose chairman was Howard B. Hall, manager, Old Colony Gas Company, and past chairman of the NEGA Sales Division. Committee members, representing 15 New England gas companies in 4 states, surveyed approximately 1500 customers. Ten pages of detailed replies received from the persons interviewed were consolidated in 21 different tables and presented as part of the main committee's report. Among the questions asked of the consumers interviewed were ones regarding future fuel preferences, range models, and the chief features that would be desired in post-war ranges. The survey results proved so interesting that several companies plan to expand their own local surveys.

In addition to the survey of 1500 consumers, the committee gathered 402 suggestions from the NEGA member gas companies covering domestic appliances, which were consolidated and considered in detail. The suggestions—received from 21 operating companies and 4 gas service companies in 5 states—showed a similarity in some respects indicating

a general opinion as to certain possible improvements.

Among other things, the report states: "The Committee hopes that individual gas companies will put aside their individual desires for special types of appliances for the good of the industry and support those manufacturers who try to accomplish mass production through standardization, simplification, and fewer models."

The NEGA directors have authorized the following distribution of the report of the Appliance Study Committee: The A.G.A., the A.G.A.E.M., all regional gas associations, the Institute of Gas Technology, all NEGA member gas companies, and all NEGA member appliance manufacturers.

The NEGA directors authorized the Kitchen Heating Committee to report on: (1) The desirability of interested gas utilities and appliance manufacturers instituting a research project on new equipment for kitchen heating and for water heating in conjunction with cooking, either as separate units or in any desirable combinations thereof, and (2) the best methods of conducting such research.

The following are excerpts from the committee's report:

"In investigating means for conducting the necessary appliance research and development, contact was established with several research agencies and with range manufacturer members of the Association of Gas Appliance and Equipment Manufacturers. A subcommittee of your committee met in New York with range manufacturers. In addition, the chairman visited several research agencies whose facilities and availability were considered by your committee.

"It was evident from data submitted that there now exists an appreciable market for heater-type ranges particularly in New England where reporting utilities showed range sales of the heater type as high as 30% of total gas range sales. Over 16,000 heater type gas ranges are now in use in this area and there is every indication of increased customer demand.

"Whereas this report deals primarily with the New England market, it was brought out that similar market conditions exist in many other areas throughout the country. Consequently, from the viewpoint of the range manufacturer, the market must be considered as substantially greater than that existing in New England alone."

An excerpt from the vote of the NEGA directors follows:

"That the Association directors endorse the desirability of conducting the research project outlined in the report of the Kitchen Heating Committee, dated December 3, 1943, concerning the development of a 3-purpose range embodying facilities for cooking, space heating and water heating by an interested group of gas utilities and gas appliance manufacturers, using the facilities of the Institute of Gas Technology or of any other appropriate organization, with the selected organization having charge of the financing with each interested party individually and directly."

In connection with the work of the Economic Survey Committee, which was appointed as a result of the suggestions made by President West of the NEGA in his address at its annual meeting in Boston last March, a Production Subcommittee and a Transmission Subcommittee made detailed studies.

The chairman of the Production Subcommittee was Edwin L. Hall, manager, Manchester Gas Company, who is also chairman of the Program Committee for the NEGA annual meeting in Boston next March. The chairman of the Transmission Subcommittee was Peter J. Rempe, president, Stone & Webster Service Corporation.

The following paragraph is an excerpt from the summary of the Production Subcommittee's report to the main committee:

"Whether in the future coal gas can be manufactured economically in plants of relatively small size will depend largely on developments both in equipment and in the art of manufacturing. Whether in the future gas requiring the use of oil for gas-making material can be made economically to supply both base and peak loads which are now supplied by many carburetted water gas plants will also depend to a certain extent on similar developments. In either case, the cost of labor, fuels and materials in the future, as at present, will have profound influence on the adaptability of each process, whether it produces gas made from coal or gas made from oil."

The possibility of expanded gas transmission facilities receives the following comment in the report of the Transmission Subcommittee to the main committee:

"A casual study of this map (prepared by Subcommittee) indicates the best interconnection possibilities as being in a radius of some 50 miles of Boston. The only other load densities in New England warranting consideration are in the Connecticut River Valley and New Haven areas. The substantial interconnection of these systems has already been accomplished. If large capacity lower cost gas plants are developed, it may be advisable to study the interconnection of the Boston area and the Connecticut River area."

Extended discussions took place in the various meetings of the main committee and of the subcommittees regarding the possibilities of and the nature of new gas production processes which would materially lower current manufacturing costs and the function which expanded gas transmission lines in New England might serve in connection with the advent of such processes.

The report suggested that the committee felt that it was not practicable to suggest the desirability of paid research along the foregoing lines being conducted by the New England gas companies at the present time, especially in view of the fact that several methods and processes of possible value are now being developed. The report states: "When any of these possibilities are developed to a stage where they may be considered ready for application in the industry, then it may well be that a study by the New England gas companies will facilitate the application of a particular process to their local conditions."

Centrifugal Blowers and Exhausters. Roots-Connersville Blower Corp., Connersville, Ind., has issued Bulletin 120-B-12 covering its centrifugal blowers and exhausters. This is a twenty page booklet in two colors, well illustrated, applying to both single and multi-stage units in many sizes.

Sectional views, types of impellers, and installation and shop cuts of the various single-stage and multi-stage units are shown.

Diesels In Gas Plants

How Much Fuel Do They Consume?

By

W. F. Schaphorst, M.E.

Newark, N. J.

"In the event that we should install a Diesel engine in our gas plant how much fuel would it consume?" That question is often asked by officials who are considering the use of a Diesel for power purposes.

It is an important question that is too often "side-stepped" by salesmen who are afraid of committing themselves. They reply, "It all depends upon the size required," or words to that effect and the prospective user is mystified by the intricateness of the situation. As a result the prospect becomes "afraid" of Diesels.

This writer has therefore made an effort to answer the above question definitely. He has gathered data on fuel consumption by modern Diesels of numerous sizes and has prepared the following table. This tells at a glance what good Diesels are doing today, the horse power varying from the smallest sizes up to and including 3000 h.p. The table applies to full load conditions.

Horse Power of Diesel	*Pounds of Fuel Used for H.P. per Hour*
50 — 60	0.45 to 0.44
60 — 70	0.44 to 0.43
70 — 110	0.43 to 0.42
110 — 260	0.42 to 0.41
260 — 500	0.41 to 0.40
500 — 1000	0.40 to 0.392
1000 — 2000	0.392 to 0.391
2000 — 3000	0.391 to 0.39
3000 — and up	Slightly less than 0.39

Thus for instance if your requirements are very small—50 h.p. or even less—you can figure on a fuel consumption of 0.45 lb. per h.p. per hour with a modern engine. If you need a 100 h.p. Diesel the consumption will be about 0.42 lb. per h.p. hour. The table shows that with increase in engine size the fuel consumption improves rapidly from the smallest sizes to 260 h.p. From 260 to 1000 h.p. the improvement is less rapid, and from 1000 to 3000 h.p. the improvement is very slight being practically 0.39 lb. per h.p. per hour for all of the sizes in that range as well as for larger sizes.

Should you want to determine the efficiency of any engine sizes, with any fuel, multiply the B.T.U. value of the fuel per pound by the number of pounds per h.p. per hour and divide the product into 2546.

As an example, if the fuel contains 20,000 B.T.U. per pound and you will require a 500 h.p. engine, the table shows that you must multiply 20,000 by 0.40, which gives 8,000 as the product. Now divide 2546 by 8000 and it will be found that the engine will have an efficiency of 31.8 per cent, which is a high efficiency as compared with most engines of other types. It means that 31.8 per cent of the heat contained in the fuel will be converted into work. Even at 0.45 lb. of fuel per h.p. per hour, other conditions being the same, the efficiency will be 28.3 per cent, which is a *high* efficiency for any engine.

Fractional Loads

The above figures relate solely to Diesels that are carrying 100% load, which means that conditions are best for minimum fuel consumption. However, since Diesel engines are commonly operated at less than full load, it is also important that prospective users should know what the fuel consumption at such loads will be. This information should be known in advance.

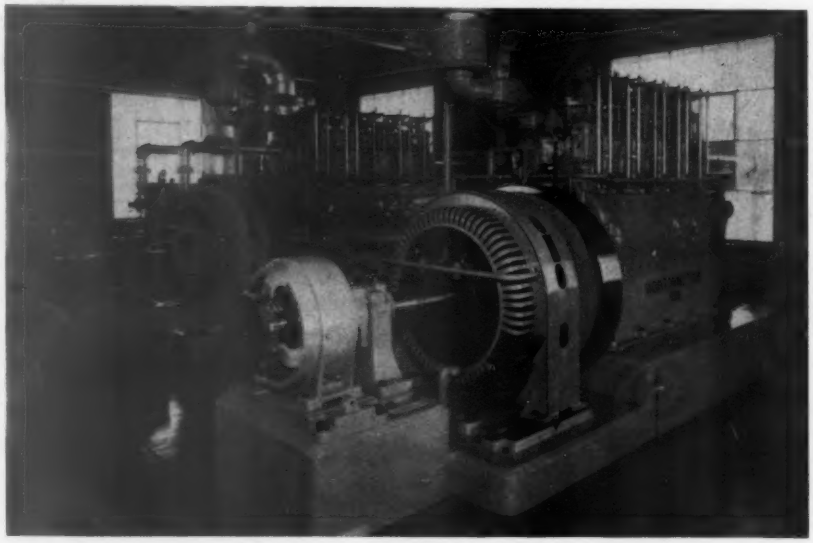
Under average conditions, using the *good* Diesels mentioned above, the writer offers the following figures as being applicable.

Percent of Load	*Multiply the Figures in the Above Table by*
100 to 85%	1.000
85 to 70%	1.010
70 to 62%	1.035
62 to 56%	1.060
56 to 52%	1.085
52 to 48%	1.110
48 to 46%	1.136
46 to 44%	1.160
44 to 42%	1.183
42 to 40%	1.210
40 to 38%	1.232
38 to 36%	1.260
35%	1.306
34%	1.327
33%	1.348
32%	1.370
31%	1.392
30%	1.415
29%	1.438
28%	1.462
27%	1.486
26%	1.511
25%	1.536

Thus for example, if you should be contemplating a 100 h.p. Diesel, and if it is quite possible that the engine will be operating at 25% of full load most of the time, as is not at all uncommon in practice, the fuel consumption at that load is obtained by multiplying the 0.42 in the first table by the 1.536 in the second table. As a result we have

$$0.42 \times 1.536 = 0.645$$

In other words, the fuel consumption will be approximately 0.645 of a pound per horse power per hour, or, 64.5 pounds per hour for the engine since it will be a 100 h.p. engine.



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Underground Gasification of Coal

By

Harold Rose,

B.Sc., A.I.C., A.M.I. Chem. E.

THE idea of converting coal to gas in the seam is not new. The possibility was first mentioned by the Russian chemist, Mendeleev, in 1888, and somewhat later by Sir William Ramsey in this country. Although the idea attracted a certain amount of attention in other countries, little practical work was carried out beyond the laboratory stage. In fact, no country took the matter seriously until Lenin, attracted by the project outlined in the British Press in 1913, coupled the problem with the plan for electrifying the U.S.S.R. The Soviet authorities were immediately attracted to the advantages which the scheme offered.

By utilizing poor seams of low quality coal, which were uneconomical or impractical to work, their potential coal reserves could be increased enormously. The reduction in the transport of coal over long distances would be a great advantage to such a vast country as Russia, where fuel supply has to be transported over hundreds of miles as a matter of course. The elimination of underground mining would provide cheaper fuel and power, which would, in turn, influence all industrial activities. The provision of low cost gas as a possible source of raw materials for the production of synthetic fuels and chemicals offers an additional attraction, and not the least important is the enormous amount of arduous human labor which would be saved, as a result of which society as a whole would reap benefit.

Experiments on single shafts were first carried out in 1933 in the Donetz Basin, and gradually the work extended to experimental stations, first built in 1937; finally, in 1940, the first industrial station was opened in the Moscow Basin. The Third Five Year Plan, 1938-1942, incorporated a project for the construction of several new plants in the Donetz and Moscow coalfields, in the Urals, Eastern Siberia, in Central Asia, and the Far East. Provision was made in the plan for the building of two stations where the control of the plant could be carried out automatically in a central control room. To give some idea of the size of these industrial plants, the projected station at Lisichansk, in the Donetz, was expected to have a daily output of 20 million cu. ft. of gas, with an average calorific value of 275 B.Th.U. per cu. ft. Two other stations with a daily output of 14 million and 8 million cu. ft. respecitvely were included in the project.

In the first experiments the seam was converted into a number of underground gas producers, by first reducing one or more panels to fragments before ignition. This method, however, was found to be unsatisfactory, and was abandoned in favor of methods which reduce underground mining operations to the minimum.

There are at least three methods available, each of which is applicable to a particular type of seam, the deciding factors usually being the inclination and depth of the seam.

(i) *Stream Method.*—This is perhaps the most successful and firmly established of all methods, and is particularly suited to steeply inclined seams. A gallery, which acts as the fire shaft, is driven along the seam, and two shafts some 200 to 300 yards apart are taken upwards along the seam to the surface. The coal is ignited and combustion maintained by blowing compressed air down one shaft, the combustible gas being tapped off at the second shaft. In this way the fire burns progressively upwards along the seam to the surface. Starting-up usually takes from two to ten hours, after which gas is produced continuously without further attention.

At one experimental station in the Donbas, working on a 6 ft. thick seam, inclined at an angle of 75°, gas was produced without interruption for 18 months, during which time 250 million cu. ft. of power gas and 70 million ft. of synthetic gas were produced.

(ii) *Filtration Method.* — This method is used for horizontal seams and requires no preliminary underground mining operations. A number of bore-holes, reaching to the seam, are arranged in concentric circles, and air is pumped down through the centre boring, the gas being withdrawn from the bore-holes of the first ring. When the gasification of this section is complete, the air is then pumped down the first ring of borings and the gas withdrawn from the next concentric ring. The bore-holes are interconnected, so that the gas underground passes through cracks and crevices from one bore-hole to those adjacent to it.

(iii) *Bore-holes and drilling method.*—This virtually is a combination of the previous two methods, and is considered suitable for gently sloping seams. If a low-grade coal is used, the air may be enriched with oxygen, or, if steam is added to the blast, a semi-water gas is obtained.

Some of the gas penetrates into faults in the seam and to the surrounding rock. This gas may be recovered by discontinuing the air blow while the gas is being pumped off. A gas rich in hydrogen is obtained in this way, which is eminently suitable for the production of synthetic fuels and chemicals.

The process can be divided into two cycles. During the air blow, power gas with a calorific value of 115 B.Th.U. per cu. ft. is obtained, while during the blow-off period a synthesis gas is obtained with a calorific value ranging from 170 to 220 B.Th.U., and with a hydrogen content which might reach 55%. If the air blow is enriched with oxygen up to 25%, these calorific values may be increased by 50% or more.

If we can judge from the considerable amount of expenditure on research and development in the U.S.S.R., and from the results published, it would appear that, although major technical problems yet remain to be solved, the teething troubles are over and the underground gasification of coal may be considered as an established fact.

Most of the published results are based on the operations of the large experimental station at Gorlovka, in the Donetz, and some of these are worthy of study. Whereas the monthly output of each miner in this Basin is 30 tons a month, the output of each operator at the underground gas station, in terms of coal equivalent, is 75 tons; thus, the productivity of each operative is more than doubled. If this figure can be achieved at an experimental station, it has been estimated that a large industrial station can increase the output per operator by 12 to 15 times as compared with conventional mining methods.

Since 80 to 90% of the fixed capi-

tal goes into surface work, and the remainder into the preparation of the panel, there is a considerable saving in the cost of operation, which has, in fact, already led to a reduction of the cost of power gas to one-third of its usual cost.

The possibilities that present themselves are great. In the first place, shallow seams and poor deposits of coal, which cannot be profitably worked by conventional mining methods, could be successfully dealt with by underground gasification.

The gas plant, now transferred to the pithead, could distribute low cost gas to industry, which might be handled through a regional scheme, along the lines of a gas grid. Alternatively, the gas may be used for cheap power generation on the site by means of a gas turbine. The Kharkov Mechanical Engineering Institute has, in fact, brought out the first industrial gas turbine which will operate exclusively on underground gas. The power generated can be linked up with the existing grid, and will incidentally supply the requirements of the station itself and the industries centered around the station, using as raw materials the products of gasification. For it is in this direction—the utilization of the synthesis gas for the production of industrial fuels and chemicals—that the process offers so much promise. The gas produced provides the basic raw material for the synthetic production of a number of key industrial chemicals.

We can envisage the possibility of replacing the monstrous slag heaps at the pithead by highly mechanized gas stations, coupled with thermo-electric and electro-chemical enterprises, running on cheap power, together with a group of synthetic chemical industries, the whole forming one integral unit running entirely on the gas generated from the seam, without a human hand having to touch the raw coal. The installation of such centralized industrial combines is bound to have a marked effect on industry as a whole by stimulating new industries and by the general lowering of the costs of production.

The Gas Industry might well take the trouble to investigate the possibility of gasifying coal underground in this country. The technicians we have. What we require are foresight and the establishment of adequate funds to enable the necessary scientific research to be carried out.

Abstract of a Lecture at a Conference of the North-Western District of the B.C.G.A., Manchester, May 28. Reprinted from Gas Journal, London.

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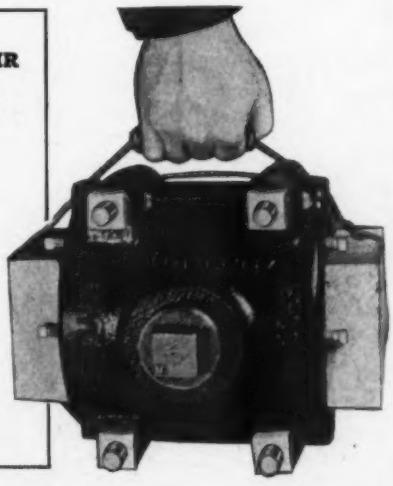

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Background Information on the Neches Butane Products Company*

ENOUGH butadiene to produce one-seventh the entire wartime program of synthetic rubber in the United States will be turned out in a single plant operated by the oil industry when the largest plant in the world producing butadiene from petroleum is completed at Port Neches, Texas, early in 1944. The first of two units, now almost completed, will be placed in operation in December, and the second will be ready shortly thereafter.

The Port Neches project had its inception on January 12, 1942, little more than a month after Pearl Harbor. On that date, Herbert Henderson, vice president of Gulf Oil Corporation, went to Washington at the call of the Government. He was told that large quantities of synthetic rubber had to be produced before the U. S. stockpile of natural rubber was depleted since the Japanese invasion threatened our natural rubber supply from the Far East.

The bottleneck of synthetic rubber production was butadiene, its principal ingredient. This could be made either from alcohol or from petroleum. Both would be needed because up to that time butadiene had been produced only in small quantities in the United States and all at once there was a demand for enough of it to produce more rubber annually than the country had ever used in any year before. The synthetic rubber goal was set at 800,000 tons. Rubber consumption in the United States in the year before Pearl Harbor was about 600,000 tons.

The Government plan was to build a number of plants, some of them to produce butadiene from alcohol and some from petroleum. Mr. Henderson suggested that a plant of 100,000 tons rated capacity be built in the heart of the Texas Gulf Coast oil region and that it be supplied with feed stocks by nearby refineries of five oil companies. He said he was confident the oil industry would supervise the construction and manage the operation when the plant was completed and it would do so without the customary management fee.

The Government officials approved the proposal in principal. Mr. Henderson got the president of his own company and the presidents of The Texas Company, The Pure Oil Company, The Socony-Vacuum Company and The Atlantic Refining Company on the telephone and explained the situation to them. They not only agreed to supervise construction and operation of the plant without profit but to furnish to the Government the services of management, advisory, technical, and legal committee members and to pay their expenses.

None of the five companies had had experience in the manufacture of butadiene, but there were other refining companies that had been carrying on research work for several years. They agreed to exchange technical information and "know how." Committees, each comprising a representative of each of the five companies, were appointed.

After a thorough study of the problem the oil men recommended on March 20, 1942, that a butadiene plant with a capacity of 100,000 tons of butadiene a year be built on open prairie land at Port Neches, Texas, midway between Beaumont and Port Arthur, and that adjacent to it the Government build two copolymerization plants which would take the butadiene and combine it with styrene to make synthetic rubber. A hundred thousand short tons of butadiene is sufficient to make 110,000 long tons of synthetic rubber known as GR-S or Buna S.

To carry out this program the five oil companies, with the approval of the Government, organized the Neches Butane Products Company to supervise design of the plant, and to manage its operation for the Government.

Two representatives from each of the five oil companies were named directors. Mr. Henderson was made chairman of the board, and W. H. Hoffman was made available by The Texas Company to serve as president. The Management Advisory, Technical, Legal, Insurance, Patent and Public Relations Committees, which had been functioning during the preliminary stages of the planning, continue to serve the newly organized company, with their salaries and expenses paid by their respective companies.

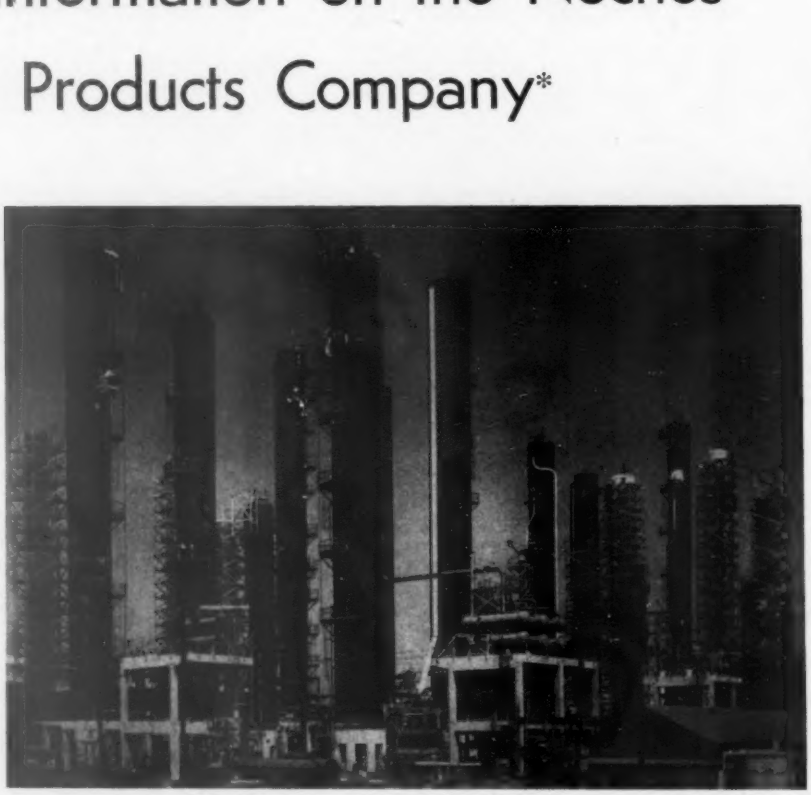

Fig. 1. These tall steel towers mark the site of the world's largest center for the production of synthetic rubber from petroleum at Port Neches, Texas. They are part of the butadiene plant which is being built and will be operated for the United States by five oil companies, who have declined to accept profit or management fee for their services. Butadiene, which is made from petroleum, is the key ingredient of synthetic rubber.

* This release approved by the War Department.

In undertaking this project, the oil industry assumed one of the toughest jobs in the war production program. It was called upon not only to produce butadiene in far larger quantities than ever before, but to adapt a process that would yield more from a barrel of petroleum than had been possible in any previous commercial operation and to utilize the remaining petroleum products for the production of high octane aviation gasoline and other war products.

In making such butadiene as was produced before the war, the yield from a barrel of petroleum was about two per cent and the remainder of the barrel could be used only for a limited number of petroleum products. To make the mass quantities of butadiene needed for the synthetic rubber program would require too much of our petroleum supply.

The oil men, pooling their research facilities, patents, and "know how," solved the problem by developing a process that would roughly use about five per cent of a barrel of petroleum and leave the remainder available for the production of high octane gasoline and other products. A small scale laboratory model was developed. Tests revealed that the process would work. The Defense Plant Corporation, a unit of the Reconstruction Finance Corporation, then awarded a contract for construction of the plant to The Lummus Company, one of the leading engineering and construction organizations in the petroleum industry. Neches is agent for The Rubber Reserve Company, the Government agency which finances and is responsible for the production of rubber and the required raw materials.

While work was underway on the butadiene plant, the key unit of the Port Neches project, the Defense Plant Corporation erected two co-polymerization plants on adjacent sites. In these plants the butadiene produced by Neches Butane Products Company will be combined with styrene, a product of the chemical industry, to make a latex, or rubber milk, which in turn is converted into a synthetic rubber gum resembling raw natural rubber. One of the plants will be operated by B. F. Goodrich Company and the other by the Firestone Tire and Rubber Company for Rubber Reserve.

Also while the butadiene plant was being constructed, each of the five participating companies expanded its facilities for the production of raw stock to be supplied to the butadiene plant and to increase its output of aviation gasoline. All told the companies have spent many millions of dollars in new construction.

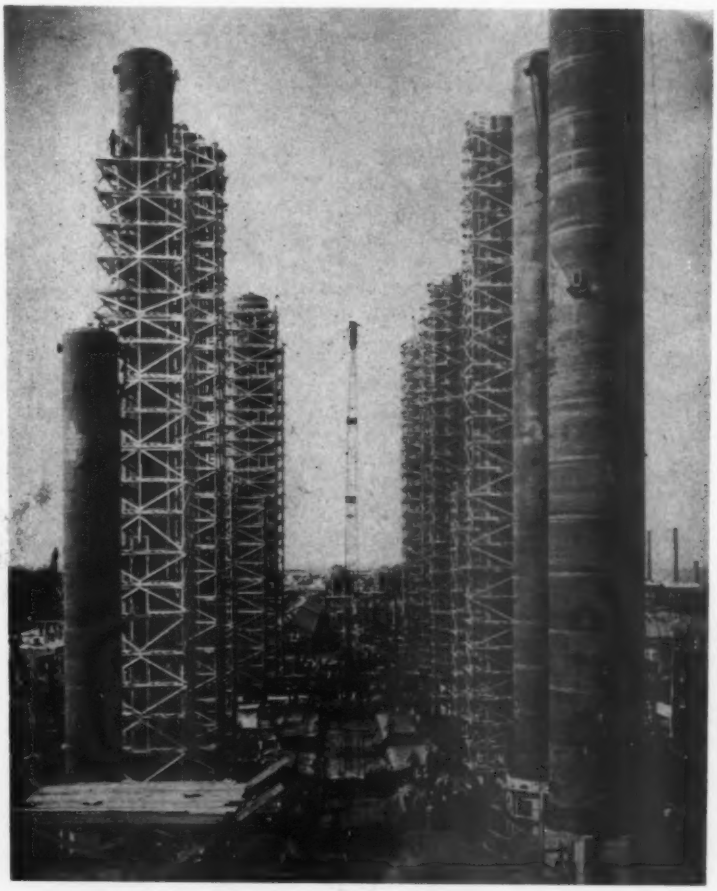

Fig. 2. The chief ingredient of synthetic rubber—butadiene—soon will be made in these giant towers by five companies of the petroleum industry serving the Government without profit. The scene is at Port Neches, Texas, and the plant, largest of its type in the world, was designed and is being constructed by executive and technical men of the five companies. The salaries and expenses of these oil men, many of whom will serve the Government for the duration in the operation of the plant, are being paid by the private companies.

How Butadiene Is Made

The process of manufacturing butadiene is complicated, but essentially it is something like this:

In the process of refining crude oil each of the five participating refineries obtains a gaseous substance known as butane-butylene, which serves as the raw stock for the making of butadiene. This raw stock is piped from the refineries direct to the butadiene plant at Port Neches, and to assure a constant supply it is stored in the large spherical-shaped pressure tanks.

The raw stock actually is a mixture of normal butane and isobutane, and normal butylene and isobutylene, although the gas is commonly called butane-butylene. The normal butylene must be isolated in a highly pure state. This is difficult to do since these materials all boil at nearly the same temperature. Vigorous fractionation is necessary, and then the product must be treated with acid and solvents before the pure normal butylene is obtained.

The second step is carried out in a dehydrogenation plant, and this is the most difficult and unusual operation in the entire process.

The work to be done in this revolutionary operation is to slice off some of the hydrogen units of the pure butylene. Catalysts and extremely hot steam are needed for part of this job. The objective is to knock off two hydrogen atoms of the butylene molecule. When this is done butylene is changed to butadiene. The process probably is best described by an oil expert who said:

"Imagine a big hall (one of the giant steel towers at Port Neches) with ten million fleas in it. They send you in with a sledge hammer and a crowbar and tell you to knock off the

right hind leg and left front whisker of each flea and then, when you've finished, to sort out all the fleas that you've maimed in the process."

The work of dehydrogenation is so difficult that only 20 per cent of the butylene is converted to butadiene while passing through this network of dehydrogenation equipment. The remaining 80 per cent is re-run and slowly but surely converted.

Superheated steam is needed in this new dehydrogenation process. Steam never had been used at this temperature by this method in industry before, and so a plant had to be developed for this purpose. It is done by using a battery of superheaters in which steam from the central steam plant is reheated.

This intensely hot steam is mixed with the butylene before it is routed through twelve dehydrogenation reactors. As the steam is then mixed with the butylene gas, it must be removed before the manufacturing process can be continued.

After the steam removal operation, the gas, now containing some butadiene, is cooled and compressed. Six 2000 horsepower compressors, enough to power 120 automobiles, are used. At this stage the product contains about 20 per cent butadiene and 80 per cent butylene. These two are separated in a series of complex treatments in another battery of giant steel towers which comprise the third, or purification step. The freed butylene goes back for re-cycle trips through the dehydrogenation plant. The final butadiene will be above 98.5 per cent pure, which unusually high degree of purity is required for the production of synthetic rubber.

About one-third of the raw material received at the plant is converted into butadiene. The remaining two-thirds is returned to the oil refineries for use as charging stock in the manufacture of 100 octane aviation gasoline.

That, in simple terms, is how butadiene is manufactured in this unprecedented war production plant.

Flexible Joints. A new book covering problems of Remote Controls, Universal Joints, Shaft Joints and Couplings, etc., has been issued by the Brooks Equipment Corporation, 90 West Street, New York.

Along with the descriptions are data sheets and blueprints of the joints themselves and the brackets, expansion couplings, assemblies, shaft hangers, accessories used for their installations.

The joints described enable shafts to be rotated at any angle—on any plane in any direction.

A registered copy of the book will be sent free to any reader interested.

STATISTICS ON NECHES BUTANE PRODUCTS COMPANY

Plant area	314 acres
Number of fractionating towers	48
Size of fractionating towers	Highest 175 feet, 14 feet diameter (About height of 17-story building)
Number of Pressure Spheres, or storage tanks	42 (largest group in history of oil refining)
Pressure required to store butadiene and raw stock	75 pounds
Steam generating capacity	50,000,000 pounds per day—60,000 boiler horse-power
Fuel required (natural gas)	78,000,000 cubic feet a day
Cooling water capacity	308,000,000 gallons a day (enough to supply water demands of a city the size of Cleveland, Ohio)
Feed stock required from five contributing refineries	18,000 barrels of butane-butylene a day.
Plant Capacity	100,000 tons (short tons) per year (This is enough to make 110,000 long tons of synthetic rubber a year, or about one-seventh of all synthetic rubber called for in the 800,000-ton Government program, or more than one-fifth of all natural rubber used in the United States in the year before Pearl Harbor, a record rubber year for the country up to that time)
Number of employees needed to build plant	About 6,000
Number of employees needed to operate plant	About 700
Hours per day of plant operation	24 hours every day in the year (Three shifts of employees)

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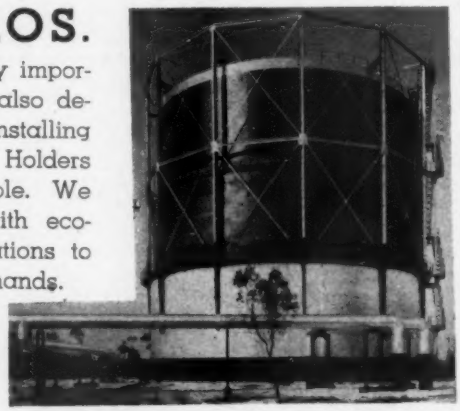

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RECENT COURT DECISIONS *Affecting Gas Utilities*

Review of Gas Employees' Disability Law

By

Leo T. Parker

Attorney at Law
Cincinnati, Ohio

A GREAT DEAL of time, effort, expense, and inconvenience is caused gas company officials and employees in suits involving disability awards to employees. In order to convey dependable legal information as to when, and under what circumstances, gas company employees are entitled to recover compensation we shall review several higher court decisions reported during 1943.

What Is Total Disability?

Total disability has been defined as a disability to engage in the important and necessary functions of a trade or profession, without the performance of which functions the insured could not carry on the trade or profession at all.

Therefore, in order that an employee is entitled to recover insurance or disability payments for "total disability" does not mean that the employee is in a state of absolute helplessness, nor mean that the employee must be in such a condition that he cannot do any part or portion of the duties pertaining to his trade or occupation. On the contrary it may exist although the employee may do some work if he is not able to do a substantial portion of the work connected wtih his occupation.

For illustration, in Equitable Life Assur. Soc. of United States v. Davis, 137 Pac. (2d) 548, reported July, 1943, it was shown that an employee was discharged. A short time after he was discharged he was examined by a physician who testified that he found him suffering from a chronic heart ailment, which in his opinion had existed at least 18 months and which during that time had grown slowly and progressively worse. The doctor testified that at the time of the examination any form of work would be inconsistent with the health of the insured.

The legal question presented the court was: Was the employee totally disabled at the time he was discharged? The court held in the affirmative, and said:

"Within two weeks after his employment ceased his examining physician said he was hardly able to walk due to a heart disorder which had slowly 'crept' upon him. Symptoms of the disorder had been apparent during his employment."

Also, see Temples v. Prudential Ins. Co. of America, 79 S.W. (2d) 608, where the court tersely said:

"If he works when he is not able to work and when it impairs or endangers his health, and his disability is of such character that ordinary care requires him to desist, then total disability exists."

Other cases dealing with the question of total disability are to be found in the annotation appearing in 98 A.L.R. 789, at pages 794 and 795. It will be interesting for readers to review the higher court cases cited in this notation. This is particularly so when it is considered that in many instances provisions in policies of life, health, and accident insurance, conditioning the insurer's liability upon total disability are so various and conflicting that it is difficult to determine whether insurance companies have strenuously endeavored thereby to evade payment if the intricacies of the language will so permit, or whether they have, perhaps with the utmost good faith, overzealously endeavored to protect themselves and their funds.

As a matter of fact, provisions for total disability in all cases of doubt generally are, liberally and fairly construed in favor of the employee.

Court Believes Physician's Testimony

According to modern higher courts the testimony presented by physicians is more impressive and given greater consideration than evidence presented by an employee who sues to recover compensation.

For example, in Kentucky v. Phillips, 172 S.W. (2d) 216, it was shown that an employee, named Phillips, filed suit for compensation against his employer claiming that on and before January 15, 1939 he "suffered permanent impairment of his lungs." The application for compensation was based on the contraction of silicosis.

Immediately following the suit he was examined by two physicians who reported in writing that Phillips was not suffering from silicosis or tuberculosis. Although Phillips introduced testimony tending to prove the contrary, the higher court refused to allow compensation.

Conversely, see Schabel v. Riddell-Robineau Mfg. Company, 245 Ky. 409. There an employee inhaled dust while disconnecting pipes blowing dust into a furnace and this caused gangrene and pneumonia resulting in death a month later. This was held to be an accident and a compensable injury, since the employee's dependents proved by physicians that his death resulted from inhaling dust.

Another important point of law is that although an employee agrees to to accept a definite and stated compensation for an injury, modern higher courts hold that the case may be reopened if there has been a change of condition of the injured workman, or if there has been some new development which shows the former award to be either inadequate or excessive.

An important higher court case decided during the past few weeks is Barber Asphalt Corporation v. Industrial Commission, 135 Pac. (2d) 266.

In this case it was shown that an employee was injured during the

course of his employment. Medical examination resulted in an opinion by the medical advisory committee for the State Commission that the employee's condition showed permanent partial disability of about five per cent. The employee being dissatisfied with the rating entered into an agreement of settlement with the employer which by its terms was for payment upon the basis of fifteen per cent permanent disability as final settlement of all claims growing out of the injury. Upon approval by the State Commission, payment was made in accordance with the agreement.

Later the employee filed a claim for additional compensation. In this claim he alleged that he was totally disabled. After introduction of considerable testimony the higher court held void the agreement to award the employee compensation on a fifteen per cent basis and allowed a permanent disability award. This court said:

"To be valid an agreement must conform to the provisions of the state law, the court or commission may approve an agreement only when its terms conform to the provisions of the act, and approval of an agreement which does not conform is void; so, an approval of an agreement which fixes compensation of an amount less than that allowed by the act is invalid."

Therefore, the law is well settled that a release executed by an injured employee covered by workmen's compensation insurance does not operate as a bar against a future claim filed subsequently by the employee.

It is also well established that a provision in a workmen's compensation act invalidating agreements by employees to waive rights under the act is not unconstitutional. See annotation in 47 A.L.R.

In Course of Employment

No employee is entitled to receive damages or compensation for an injury not received in the course of his employment.

An accident does *not* arise "in the course of employment" when it occurs while the employee is doing something entirely different from his regular employment, or where he is on his way to work, and before he has reached the premises of the employer, or the place where his work is to be done. The exceptions to this latter rule are, namely: Where the employer furnishes transportation to the place of work, or the employee travels over a route expressly or impliedly authorized by the employer; or while the employee is traveling upon the premises of the employer; or the employee is coming from a place maintained by the employer for the use of the employees as an incident of their employment; or where the employee is using an automobile or other vehicle furnished by the employer; or the employee is delivering merchandise, money, or some report or other document or message pertaining to the employer's business; or when the employer controls, or has the right to control, the acts of the employee then the employee is legally "acting within the scope of the employment."

Under any other circumstance the employer is not liable for an injury sustained or effected by an employee.

For illustration, in Hantke v. Harris, 54 Pac. 293, it was disclosed that while an engineer of a gas plant was going to work in his own automobile he negligently collided with another motor vehicle causing serious injury to the occupant. The injured person sued for damages contending that the company or employer was liable because the testimony proved that he paid the engineer a part of the expense of operating the automobile. However, the court held the company *not* liable.

Therefore, it is quite apparent that before a gas company may be held

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liable in damages for acts of an employee, it must be shown that the relationship of principal and agent, or employer and employee, existed at the time the damage was done, and that the employee was acting in the course of his employment. The term "in the course of his employment," means "while engaged in the service of the master," and is *not* synonymous with the phrase "during the period covered by his employment."

Bankrupt Laws Not Effective

Many readers believe that only a gas company is liable for negligent acts of an employee. However, this is not so because the injured person may sue and recover damages from the employee. Moreover, the employee cannot obtain a valid discharge in bankruptcy if he wilfully effected the injury for which a damage judgment was awarded.

For illustration, in Reell v. Central Illinois Electric and Gas Company, 45 N.E. (2d) 500, reported February, 1943, it was shown that a judgment of $2,500 was awarded a man who was injured in an automobile collision by a truck driver, named Reell, employed by a gas company. Soon after the judgment was rendered Reell was discharged in bankruptcy believing that he had been relieved from paying the $2,500 judgment. However, the injured man sued Reell and alleged that Reell had recklessly, wilfully and wantonly operated and drove the automobile which caused the injury. In holding that Reell's discharge in bankruptcy had not relieved him from paying the $2,500 judgment, the higher court said:

"The term 'wilful and wanton' has the same meaning as the term 'wilful and malicious' employed in section 17 of the Bankruptcy Act and under the express terms of that section Reell was not released from civil liability under the judgment."

Also, it is important to know that this Illinois higher court held that where an injury results from a wilful violation of a statutory duty, the question of contributory negligence of the injured person will not be considered by the court. In other words, when a person is injured by one who violates a state law, the fact that the injured person contributed to the injury by his negligence is not important in a suit for damages.

However, this rule of law is not applicable if the driver of the motor vehicle, that effected the damage, was not violating a state law when the accident occurred.

For illustration, in Sayeg v. Kansas Gas and Electric Company, 131 Pac. (2d) 648, reported January, 1943, an occupant of an automobile was injured when a collision occurred with a vehicle owned by a gas company. Although the lower court awarded the injured person damages, the higher court reversed the verdict, saying:

"The conclusion is inescapable that the collision would not have occurred except for the negligence of both parties. The finding is clear that she (injured person) could have avoided the accident if she had not been negligent."

Laboratory Equipment. Catalog 600 issued by the Precision Scientific Co., 1750 N. Springfield Ave., Chicago 47, Illinois, is titled "Laboratory Utilities," comprising 112 pages, 8½ x 11", containing detailed information on an extensive variety of laboratory apparatus and equipment, many new "wrinkles" in familiar items, dozens of practical ideas for stepping up laboratory efficiency. Subjects include autoclaves, burners, centrifuges, digestion and extraction, distillation, heaters, hot plates, sieves, stirrers, shakers, titration illuminators, water stills.

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War Production Board and

Other Administrative Orders

Part 4500—Power, Water, Gas, and Central Steam Heat

(Supplementary Utilities Order U-1-a, as Amended Dec. 10, 1943)

Section 4500.2 **Supplementary Utilities Order U-1-a is hereby amended to read as follows:**

4500.2 **Supplementary Utilities Order U-1-a—(a) Permission to build certain extensions.** Notwithstanding the provisions of paragraph (h) (1) of Utilities Order U-1, extensions of electric, water, gas, and central steam heating facilities may be made or connected by producers to serve facilities of the Army, Navy, Maritime Commission, War Shipping Administration, or Civil Aeronautics Authority, upon the direct order of such agencies when all of the following conditions are satisfied:

(1) The total cost of material for each extension, exclusive of any part built by or for the consumer, does not exceed $1500 in the case of underground construction or $500 in the case of other construction. No job or project may be subdivided to come within these limits.

(2) No other producer can render the same service with lesser amounts of critical material.

(3) The extension does not duplicate an adequate service already installed or constitute a stand-by service.

(b) Other orders. This order does not constitute a release, in the case of gas producers or consumers, from the restrictions of Utilities Order U-7 or Limitation Order L-174.

Issued this 10th day of December 1943.

Part 3288—Plumbing and Heating Equipment

(Interpretation 2 of General Limitation Order L-199)

Plumbing and Heating Tanks

The following interpretation is issued with respect to General Limitation Order L-199.

The definition of "tank" in paragraph (a) (1) includes tanks produced for underfired storage water heaters, and consequently the restrictions in the text of the order apply to such tanks, but none of the schedules attached to the order apply to them.

Issued this 22d day of November 1943.

War Manpower Commission

Cleared and issued through the facilities of the Office of War Information.

The War Manpower Commission today announced the amendment of instructions for the determination of the essentiality of an establishment by providing that the end-use of a product be considered as an additional test.

The essentiality of an establishment, it was explained, depends not only upon its being engaged in an activity included in the List of Essential Activities, but also upon the extent to which the product or service is used to meet war needs or minimum civilian requirements under wartime conditions.

The War Manpower Commission's ruling in earlier instructions, which are still in effect, provided that whenever the essential and unclassified activities are not separate, as in the case when the same workers are engaged in both departments, the establishment will be classified as essential only if 75 percent of its activities are devoted to production of items on the essential list.

Office of War Information

Bureau of Internal Revenue is appealing to trade association executives for help in impressing upon their members the importance of early distribution of Form W-2 to their employees. This form is a statement showing total wages paid during the calendar year 1943 and the amount of income and Victory tax withheld from such wages under the provisions of the new "pay-as-you-go" income tax plan.

January 31, 1943 is the deadline for distribution of the forms to employees and for the filing by the employer of duplicates, together with the employer's quarterly report of taxes withheld (W-1), with the Collector of Internal Revenue in the employer's district. But, it is highly important that every employer learn immediately about his duty to prepare the forms and to make, in advance of January, any necessary preparations for the task. Particularly, early arrangements will be necessary for those employers who may need to assign special personnel, and arrange adequate records.

Next year, 50 million people will be required to file income tax returns, the Bureau of Internal Revenue estimates, and the task will be more complicated than ever before. The demands for help from the Collectors of Internal Revenue will be unprecedentedly great, and it is important that taxpayers have the information they need for filing at the earliest possible date, so they can file their returns in time.

Employers will be supplied with copies of the W-2 Form by the Collectors of Internal Revenue and may obtain any additional quantity needed from their local collector. The form requires these simple facts: (1) name of employee, complete address and Social Security number, (2) name and address of employer, (3) amount of wages paid the employee during the calendar year 1943, and (4) amount of income and Victory taxes withheld during the calendar year 1943. Distribution of the forms early in January is highly desirable.

Office of Price Administration

REGULATION

PART 1499—COMMODITIES AND SERVICES

Repair of certain appliances and equipment

A statement of the consideration involved in the issuance of this Supplementary Service Regulation No. 22, issued simultaneously herewith, has been filed with the Division of the Federal Register. For the reasons set forth in that statement and priced under the authority vested in the Price Administrator by the Emergency Price Control Act a

1942 as amended, and Executive Orders Nos. 9250 and 9328, Supplementary Service Regulation No. 22 is hereby issued.

§ 1499.674 *Maximum prices for repair of appliances and equipment*—(a) *General rule.* Any person engaged in the repair or maintenance of appliances and equipment (as defined below), who uses a customer's hourly rate to determine his maximum prices, shall determine his maximum customer's hourly rate for such services by any one of the following methods:

(1) He may charge the highest customer's hourly rate actually charged by him in March 1942 for the same service to a purchaser of the same class; or

(2) He may multiply by 2 the average basic hourly wage rate (as defined below) paid on October 3, 1942, to employees performing the particular type of service; or

(3) He may add 60c to the average basic hourly wage rate (as defined below) paid on October 3, 1942, to employees performing the particular type of service.

(4) He may, if he employs a total of not more than 8 persons and if wage increases paid by him have been exempted from the provisions of Executive Order No. 9250 by the National War Labor Board and do not violate any regulations of that Board, add to a customer's hourly rate determined under subparagraph (2) or (3) an amount equal to the increase since October 3, 1942, in the average basic straight-time hourly rate for mechanics performing each type of service. Adjustments under this subparagraph (4) may not be made more often than once every 30 days.

(5) Where the rates under subparagraph (2), (3), or (4) are not divisible by 5c, they may be adjusted upward to the nearest amount so divisible.

(b) *Rule for persons having no employees.* Any person subject to this regulation who does not employ any mechanics to perform such work may determine his maximum customer's hourly rate for repairing appliances and equipment by either of the following methods:

(1) He may charge the highest hourly rate which he charged in March 1942 for the same service to a purchaser of the same class; or

(2) He may charge the maximum hourly rate of his most closely competitive seller who does employ mechanics to perform the service.

(c) *Minimum charges for service calls, etc.* Minimum charges and mileage rates may not exceed the March 1942 minimum charges and mileage rates to the same class of customer; except that any minimum charge made in March 1942, which was based upon a stated minimum of time, may now be based upon the same minimum time applied to the hourly charge permitted by this regulation.

(d) *Records.* Any person who increases his prices under this regulation shall prepare a statement setting forth:

(1) His maximum customer's hourly rate for each type of service;

(2) The name and address of every employee who was engaged on October 3, 1942, in performing appliance and equipment repairs. (Show what type of service was performed by each employee; do not list clerical, supervisory and non-productive employees.)

(3) The hourly wage rate paid on October 3, 1942 to each employee so listed;

(4) In the case of sellers adjusting their prices under paragraph (a) (4), a statement of the hourly wage rate of each employee, on the date of any price increase made under this regulation.

(5) A reference to the paragraph of this regulation under which he has computed his ceiling prices.

This statement shall be retained in the seller's files and may be inspected by the Office of Price Administration. A signed copy of the statement shall be filled with the seller's local War Price and Rationing Board on or before the date of any price increase effected under this regulation. No price increase hereunder shall be lawful until such statement has been filed.

(e) *Invoice.* Any person subject to this regulation shall, upon request, furnish the customer with an invoice for such service, separately showing the hourly rate for the service rendered to the customer, the number of hours worked and any charges made for parts and materials.

(f) *Posting.* When a price is increased as authorized herein, the seller shall post conspicuously in his place of business a notice setting forth his new maximum customer's hourly rate for each service involved. This notice shall be posted in the following form:

CEILING PRICES FOR LABOR

Service	*New hourly rate*
.....	.....
.....	.....
.....	.....
.....	.....

(g) *Definitions.* (1) "Appliances and equipment" means mechanical, electrical or gas appliances commonly used in homes, hospitals, hotels, institutions, offices, retail establishments or schools, including but not limited to electric fans, lamps, refrigerators and refrigerating equipment (up to 25 h.p.), water coolers, air conditioners (up to 25 tons capacity), sewing machines, vacuum cleaners, washing or ironing machines, commercial or domestic kitchen equipment, radios and phonographs (not primarily designed for commercial, military or police use), and stoves. The term does not include gas unit heaters, furnaces, industrial equipment, water heaters, oil burners, typewriters, adding machines, dictating

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machines, duplicating equipment or other office machines.

(2) "Average basic hourly wage rate" is a rate determined as follows: Add together the straight-time hourly wage rates of all productive mechanics (excluding supervisory and clerical employees) regularly engaged in performing a particular type of service. Divide the sum of these by the number of such mechanics employed. This will give you the average.

This supplementary service regulation shall become effective December 27, 1943.

NOTE: The reporting and record-keeping requirements of this regulation have been approved by the Bureau of the Budget, in accordance with the Federal Reports Act of 1942.

Issued this 20th day of December 1943.

CHESTER BOWLES,
Administrator.

REGULATION

PART 1499—COMMODITIES AND SERVICES

Charges for overtime work

A statement of the considerations involved in the issuance of Supplementary Service Regulation No. 21 has been filed with the Division of the Federal Register. For the reasons set forth in that statement and under the authority vested in the Price Administrator by the Emergency Price Control Act of 1942, as amended, and Executive Orders Nos. 9250 and 9328, Supplementary Service Regulation No. 21 is hereby issued.

§ 1499.673 *Charges for overtime work.* Persons performing services covered by Maximum Price Regulation No. 165, whose maximum prices are based upon a customer's hourly charge for labor, may increase such hourly charges in accordance with this regulation when their employees directly engaged in performing such services work overtime and are paid for overtime work at overtime rates. The following rules shall apply:

(a) *When customer requests overtime work.* Persons covered by this regulation may make an additional charge for work done at overtime wage rates in overtime hours if the customer actually requests that the work be done in overtime hours and agrees to pay the additional charge. The ratio of the overtime charge to the regular charge shall not exceed the ratio of the overtime wage rate to the regular wage rate; i.e., if overtime wages are one and one-half times regular wages (time and one-half for overtime) the overtime customer's hourly rate may be one and one-half times the regular customer's hourly rate. This paragraph shall not apply with respect to charges for work done in any overtime hours which have been taken into account for the purpose of increasing hourly rates in the manner authorized by the next paragraph.

(b) *General rule for 48-hour week including 8 hours overtime.* Persons whose employees directly engaged in performing such services regularly work 40 hours a week at straight-time rates and 8 or more hours at overtime rates may add the following sums to their maximum hourly charges established under Maximum Price Regulation 165:

Where overtime is paid for at times straight-time rates—5 cents per hour to any hourly charge under $1.75; 10 cents per hour to any hourly charge from $1.75 up to but not including $3.50 per hour; 15 cents per hour to any hourly charge of $3.50 or over.

Where overtime is paid for at double straight-time rates—10 cents per hour to any hourly charge under $1.75; 20 cents per hour to any hourly charge from $1.75 up to but not including $3.50; 30 cents per hour to any hourly charge of $3.50 or over.

(c) Except as otherwise provided by this regulation, Maximum Price Regulation No. 165, as amended, remains in force.

This supplementary service regulation shall become effective December 27, 1943.

(56 Stat. 23, 765; Pub. Law 151, 78th Cong.; E.O. 9250, 7 F.R. 7871; E.O. 9328, 8 F.R. 4681)

Issued this 20th day of December, 1943.

CHESTER BOWLES,
Administrator.

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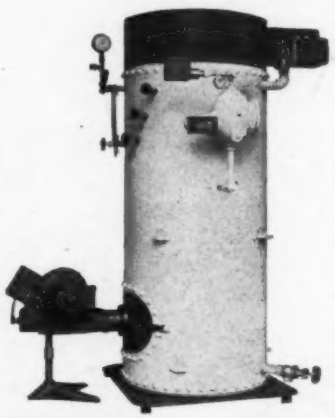

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Suggestions for Post-War Planning

By
Charles R. Bellamy
Vice-President Columbia Engineering Corporation
New York, N. Y.

THE QUESTION of whether or not industry at this time should make plans for the post-war period is one of general interest. A great many leaders in government and in industry have given encouragement to such planning, with the result that the American Gas Association, the National Association of Manufacturers, and other trade organizations, as well as numerous companies, have set up post-war planning committees. There are, however, in our industry, just as in others, a few leaders who take the position that planning of this nature is mainly lost motion and that 100% of our effort should be devoted towards winning the war in the shortest time possible.

While everyone agrees that the war effort is our first and greatest consideration, the majority of business leaders appear to think that some study should be given now to the social and economic changes that are resulting from the war and plans made to meet anticipated post-war conditions. It is the belief of these leaders that constructive work can be done along this line, without in any way interfering with the war effort, which will have a stabilizing effect when the transition is made from a war-time economy to a peace-time economy.

The General Electric Company, in its last annual report, has the following to say about its post-war planning committee:

> **"This committee has carried on and will continue such long-range planning activities but only to the extent that they do not interfere with the full discharge of your company's responsibility in the present emergency."**

This statement, it is believed, expresses the thinking of most business leaders.

It is generally expected that both private industry and the government will make a sincere effort to control post-war business conditions to the extent that there shall be neither a depression nor wild inflation. The possibility of doing this successfully is the subject of a great deal of discussion, and any conclusion reached at this time is, of course, largely a matter of opinion. The Brookings Institution study entitled "Collapse or Boom at the End of the War" lists the various factors as follows:

Favorable Factors:
1. **Retarded demobilization.**
2. **Foreign reconstruction requirements.**
3. **Housing deficiencies.**
4. **Shortage of consumer goods.**
5. **Deferred maintenance.**
6. **Accumulated consumer credit.**

Unfavorable Factors:
1. **The unemployment problem.**
2. **Shortage of working capital.**
3. **Problem of reconverting.**
4. **High taxes.**
5. **Unfavorable cost-price ratio.**

Some of the specific post-war problems that confront the gas industry are as follows:

1. **Source and adequacy of gas supply.**
2. **The re-employment and training of former employees now in service.**
3. **The effect of increased income levels upon gas consumption.**
4. **Replacement market for present appliances.**
5. **New home market.**
6. **Home heating market created by war-time fuel shortages.**
7. **Method of serving new developments economically.**
8. **Piping for factory-built homes.**
9. **Possibilities of standardization of appliance parts.**
10. **The design of appliances with greater customer appeal.**
11. **The kitchen of the future and the need of coordinating the efforts of manufacturers of different appliances.**
12. **Appliance marketing policy. Utility marketing versus dealer marketing.**
    Particularly important to manufacturers of appliances in determining their policies.
13. **Possibilities of summer air conditioning.**
    One large utility company in the East is devoting most of its planning effort to this development.
14. **New possibilities for industrial gas, radiant burner, high speed metal treating, etc.**

This incomplete list is sufficiently long to show that there are plenty of problems worthy of our attention, and it also indicates that there may be great opportunities ahead for the gas industry.

No one, of course, knows exactly what even the immediate post-war period will be like, but we are pretty sure that certain big problems will have to be met. Through study of these problems by both government and business this country should be prepared to make the transition from wartime economy to peace-time economy in an orderly manner and with minimum inconvenience to the general public. As a part of private industry it is our duty, therefore, to cooperate with other industries and the government along these lines. Our problem today, therefore, is: What plans should be made now in the interest of our own individual business.

Such questions as gas supply, pipe line extensions and changes are with us today as always and, as usual, are receiving careful attention. We have always had to plan for such things; undoubtedly always will. Today, however, we are doing a tremendous volume of temporary business on the basis of war requirements. When peace comes, as we hope it will soon, we will have to change many of our ways of doing business. We will have to return to some of the old methods, and if we are to grow and prosper we will have to adopt some new methods and policies in accordance with changed conditions. It is this type of problems that should be dealt with under post-war planning.

It seems to me there are three major questions for us to answer as follows:

1st. What will be the spending power of the general public in the post-war period and how will it be distributed?

2nd. What will we as an industry have to offer the public in the way of attractive appliances and services?

3rd. How will we offer these appliances and services to the public?

This latter question concerns itself with merchandising methods, sales organization, dealer organization, advertising, etc.

An excellent study of post-war conditions was recently presented at the University Club, New York City

by Sumner H. Slichter of Harvard University. His findings can be summarized about as follows: When the war is over the expenditures of the government will drop from about $100,000,000,000 to about 20 or 25 billion dollars per year. Large as this shrinkage in government spending will be, it is believed that the shift to peace-time production can be accomplished without any great business collapse. The main reason given for this opinion is that the plant conversion problem is much less serious than has been generally supposed, and it is pointed out that difficult conversion problems will be confined to industries responsible for less than 10% of commodity production.

According to Mr. Slichter the backlog of deferred demand and shortage will be large—10 billion or more by mid-summer of this year, and 25 billion or more by mid-summer of next year.

Surplus liquid assets, he says, will be far larger than ever before in our history. During 1942, for example, gross savings by individuals amounted to 30.6 billion dollars, of which 23 billion dollars were in highly liquid form, such as cash, demand deposits, time deposits, war savings bonds, etc. In 1941, and even in 1940, there were large increases in liquid savings. All in all, during the last three years individuals, apart from corporations, have accumulated more than 30 billion dollars of savings in highly liquid form, savings which they intend to turn into goods within the next several years. Part of these savings will be used to pay taxes in 1943, but it is safe to say that at the end of 1943 the surplus savings of individuals will be larger than ever before—close to 50 billion dollars, and possibly more. Never in the country's history has there been a reserve against unemployment even remotely approaching this in magnitude. This huge volume of surplus savings, Mr. Slichter believes, is a great protection against post-war deflation; but he warns that it obviously does create great dangers of an uncontrolled post-war boom.

By 1945 or 1946, Mr. Slichter says, our gross national production may approximate 155 billion dollars. Such a production figure in constant dollars would be about 50% above 1940 but would represent only a normal increase over 1929 production. With annual expenditures of around 155 billion dollars, this authority figures that the demand for automobiles will be somewhere between 4 and 5 million per year and that the demands for housing will be enormous. The increase of families alone should provide a demand for millions of additional homes by 1945. But, far more important will be the effect of higher incomes upon the quality of housing demands. Residential construction at the rate of 6 billion dollars per year for several years is Mr. Slichter's estimate. It is worth noting that this figure checks very well with the estimate made by the A.G.A. Post-War Planning Committee, that the number of new homes to be built in the post-war period will be approximately 1,000,000 per year for a 10-year period. So much for Mr. Slichter's findings.

There are, of course, many intangible factors connected with post-war planning, but it does seem to me that if industry (capital and labor) and government cooperate in any sensible way this country should begin a new period of growth and prosperity shortly after the war ends. There should be great purchasing power, much better distribution than ever before, and all this should be very favorable to the gas industry. Many customers who heretofore could afford gas service for only one or two purposes will undoubtedly be in position to improve their living standards and be excellent prospects for new business. It is altogether possible that after the war the demands for gas will grow faster than they have in many years, and that our various operating companies' estimates as to their future requirements will have to be revised upwards. As I see it, the possibilities of our business and for the gas business in general depends upon two things: first, general business conditions; second, on the quality of our service and the soundness of our sales policy.

Most everyone is agreed that the gas industry as a whole can expect the most aggressive competition from the electric industry for the cooking load. This competition is almost certain to start as soon as hostilities cease, for the large electric manufacturing companies are ready now and many electric utilities are making plans along this line. In my opinion this approaching struggle for business will be a most important one to the gas industry, for—make no mistake about it!—the cooking load is not only the base load, but it is the bread-and-butter business of the gas industry. It is not only important by itself, but it is the key to two other important services, namely, refrigeration and water heating.

All authorities appear to agree that a tremendous potential market for modern kitchen ranges will be opened up in the post-war period, a market based upon probably 1,000,000 new homes per year and anywhere from 500,000 to 1,000,000 obsolete or worn-out units per year. The new potential market for refrigeration and water heaters should be of like magnitude. These combined markets constitute big business which should belong largely to the gas industry. Surely it is business worth planning for, especially when we know that competing fuels are surveying it with envious eyes.

It is well for us, I think, to face some plain facts in connection with the anticipated competition between gas and electricity for the cooking load. The salient facts in this struggle, I believe, are as follows:

1. Gas is a far more economical fuel for cooking than electricity. This is a very desirable feature but not necessarily a decisive advantage.

2. The gas range, properly installed, is a better cooking machine than an electric range, according to unbiased authorities. This is a very important advantage but one that unfortunately has not been appreciated by the American housewife.

3. Electric cookery has been considered cleaner and cooler than gas cookery. This is an advantage that electricity has enjoyed but one that does not necessarily belong to electricity. Careful tests indicate that a gas range (when properly installed, with provision for disposing of the products of combustion and vapors) can provide a cleaner, cooler kitchen than the present electric range.

4. The electric range has been offered in connection with an efficiently designed and strikingly attractive all-electric kitchen. This is a feature that has great selling appeal and is probably more important than any of the other features so far named. To offset this advantage the gas industry needs to offer as attractive and as efficient an all-gas kitchen or combination kitchen, including refrigeration, range, dish washer, kitchen cabinet, etc., as the electric industry. In other words, the gas industry must offer just as attractive a kitchen lay-out of standardized and coordinated units as that offered by the all-electric kitchen. Since the gas industry has no one manufacturer making all of this equipment, there is immediate need of coordinated activity on the part of several manufacturers. This I believe to be one of the most urgent problems now facing the gas industry.

Now, just a word or two about house heating. Personally, I think that the demand for house heating gas after the war will be extremely large. My reasons for this opinion are: (1) more people should be able to afford gas; (2) enormous residential construction of better type homes; (3) uncertainty about oil supply; (4) increased cost of coal. Gas is recognized everywhere as the most convenient and best fuel for

house heating. Certainly, if there is prosperity in this country, more and more people will want to heat their homes with gas. In this connection the possibilities of year around air conditioning should not be overlooked.

From all that has been said so far it is quite evident that I am very optimistic about the market possibilities of gas. The possibilities for growth are a challenge to the gas industry but its actual growth will depend upon how well the industry meets that challenge. In order to take advantage of possible opportunities there is much work that has to be done without delay, and there is need of real team-work on the part of utilities and manufacturers.

This all leads up to the big question regarding what definite steps can the individual utility take at this time to prepare for the post-war period. Here are two suggestions:

I. Appoint an Executive Post-War Planning Committee, the personnel of this Committee to be made up of the major executives of the company. This Committee to be charged with the following duties:

(a) To direct the utility's cooperation with the American Gas Association and other national industrial and governmental associations and to see that working sub-committees cooperate with local industries and the various civic and state organizations.

(b) To formulate and establish an after-the-war employment policy.

(c) To cooperate with the manufacturers of gas equipment and encourage them to perfect and standardize their products and at the same time coordinate their efforts in such a manner that the gas industry will be able to offer the public a model kitchen as attractive as and more efficient than that which is to be offered by the two big electric manufacturing companies.

II. Appoint a director or working sub-committee to study local conditions and to formulate a definite and sound post-war merchandising policy.

From a sales standpoint the important thing is to be ready to go after new business to replace war business just as soon as war restrictions are lifted. In meeting the competition of the immediate post-war period the industry or company that gets going first with well prepared sales plans is going to have a very material advantage.

It should be the duty of this committee to find out what the customers want, what appliances will be available for both the old and new markets, and formulate a sound merchandising program. In cases where the company is to do its own merchandising the committee should work out all details for setting up an adequate and efficient sales organization. In cases where the merchandising has been done exclusively through dealers, the committee should investigate carefully the present status of these dealers and determine how much help they will have to have in order to carry on a sound sales campaign. It is quite possible that by the end of the war many dealer organizations will have been so weakened that they will not be dependable for carrying out the merchandising effort which will undoubtedly be called for. This is a delicate question and an important one, which should be answered before the real competition for domestic business starts. As soon as a decision has been reached regarding the merchandising policy this information should be passed on to the A.G.A.E.M. This is important, for the time and money that equipment manufacturers will devote to developing new and improved types of appliances will depend largely upon how aggressively the gas utilities propose to go after business.

In addition, the committee should draft a general advertising program and also do considerable missionary work among architects and residential builders. It would be well to have one or two industrial engineers on the committee, for the industrial field also has important business possibilities. It is altogether possible that recent developments, if properly advanced, will open up valuable new markets for gas, so that the post-war demands for industrial gas will be very large. In short, this committee is to be charged with the responsibility for making all necessary preparations for an aggressive sales campaign to start promptly when Victory Day arrives.

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Heat Treating. Bulletin 83 of Despatch Oven Company, Minneapolis describes the principle of heat distribution employed in their "C.F." furnaces for heat-treating tools, dies, parts, etc. One of the gas fired units is diagramed in detail.

Liquid Level Control. Floatless level controls for liquids and powders is described in bulletin 1100 issued by Photoswitch Incorporated, 77 Broadway, Cambridge, 42, Mass. The principle of control employs a series of rugged electronic relays.

What 500 Installations Have Revealed About Radiant Heating

By

Charles A. Hawk,

Engineering Service Department
A. M. Byers Company, Pittsburgh

VERY RECENTLY we received a letter from the Editor of House and Garden Magazine, which practically bowled us over. The letter was a preliminary report of a survey which had been conducted for House and Garden by a well-known research organization in an attempt to find out what John Q. Public was actually thinking about for his post war house. A questionnaire had been mailed to a list of 5000 subscribers and one of the questions asked was "What type of heating system would you like to have?" When the returns (which were unusually high) were tabulated, it was found that better than 40% wanted a Radiant Heating system. The circumstance which makes this result so surprising is the fact that no one, to the best of my knowledge, has ever spent a cent to directly promote with the public the use of Radiant Heating.

Of course surveys of this nature are always open to some question and the importance attached to the results is largely a matter of personal opinion. However, I believe you will agree with me that it would be safe to consider the results of this particular survey as indicating a strong trend, if nothing more.

Now, let's consider for a minute what this huge and hitherto unsolicited public demand would mean in the heating industry if the war were to end tomorrow and materials freed within a short time thereafter. If I can safely base my opinion on the correspondence from architects and engineers coming across my desk every day, I should say that confusion would reign.

The Byers Company has spent a lot of years and a lot of money studying the subject of Radiant Heating because as manufacturers of wrought iron, a specialty product, it behooves us to know as much as possible about the application of that product in various fields. We have felt for a long time that Radiant Heating was a "natural" market and we consequently felt that considerable research expenditures were justified. However, the storehouse of information we have built up over the years isn't doing anyone any good until it is placed in the hands of those who can put it to useful work.

Right at this point I feel that it would be apropos to state clearly the exact position of the Byers Company in the matter of Radiant Heating. We earn our living from the manufacture and sale of wrought iron pipe —we are neither architects nor engineers. Rather, we consider these professions to be our customers and friends and we have neither the desire nor the ability to preempt any of their functions. We like to feel that we are consultants on the use of a specialty material and it is in this spirit that we have developed information to be generally available to all architects and engineers for the asking.

In order that this discussion may proceed from a common starting point, suppose we begin with an accurate understanding of exactly what Radiant Heating is. Reams and reams have been written to describe Radiant Heating but in the final analysis it is nothing more than a system of producing comfort conditions by means of large, warm, room surface areas instead of depending on the movement of relatively high-temperature air currents.

Heating Principles

When described this way, a radiant heating system doesn't seem to be much different than a conventional system and you might naturally wonder what all the shouting is about, but suppose we look at the conditions which prevail in spaces heated by ordinary means. Regardless of the type of convection system, no direct attention is given to cold room surfaces such as outside walls, ceilings, etc., with the result that heat loss by radiation from the body is often greater than is comfortable even though the air is quite warm. A good example of this condition is the "Cold 70" with which you are all familiar.

In a Radiant Heating system the temperature of these cold surfaces is raised — either directly or by reradiation — and thus the body's radiant heat loss is held at a comfortable level. The importance of this method of approach to the comfort problem is obvious when you consider that the major portion of the heat dissipated from the body is in the form of radiation loss — something in the neighborhood of 50 to 60 per cent of the total heat given off. This simply means that once an accurate control is established over the radiating factor, the comfort problem is near to being solved.

This basic fact is absolutely necessary to an understanding of the principles of Radiant Heating and is the major reason for the tremendous enthusiasm of those people who live or work in radiant heated spaces. You see, these people become used to conditions in which the heating system behaves much the same as the reradiation of electric lights. It produces a sensation of gentle warmth such as that experienced on a bright spring day—there is no sensation of stuffiness, cooked air, or drafts.

The basic principles of Radiant Heating have been known for many, many years. There is evidence in some of the old ruins on the British Isles that the ancient Roman conquerors employed a form of radiant heat by running the flues from their fires under the floors and around the walls. However, the idea remained unused as far as anyone can discover, until about 35 years ago when an English heating engineer began to experiment. Since that time a great many installations in all types of structures have been made in England and on the continent. About 15 years ago American engineers began to make practical use of the system but the idea made very little headway until about 6 or 7 years ago. The Byers Company watched the progress of the system very closely since the first installation in this country, because it was felt to be a natural market for wrought iron. Bit by bit little isolated scraps of information were accumulated and pieced together, some basic research was performed directly and in collaboration with others, and a very thorough and

Transcript of an address delivered by Mr. Hawk, Nov. 10, 1943, before members of the Engineers' Club of Omaha, Nebraska.

Fig. 1: The radiant heating system for this $3000 home in Oaklyn, N. J., follows virtually the identical installation plan used in the huge war plant shown Fig. 2. The system required only 400 feet of wrought iron pipe, the coils being imbedded in a six-inch concrete floor slab.

Fig. 2: This shows one of the largest industrial installations of radiant heating in the world. It is at Sperry Gyroscope's new plant. It utilizes 19,000 feet of 1½-inch wrought iron pipe. The radiant heating pipe coils were imbedded in the concrete slab that serves as the factory floor.

consistent study of the principles involved has been carried out. Accurate case histories have been kept of several hundred installations so that the information I shall pass on to you will be in the form of a report on a successful technique rather than anyone's opinions or guesses.

I have described a Radiant Heating system as one in which heat is brought into large room surface areas such as floors or ceilings. Experience seems to indicate that the simplest and easiest method of accomplishing this is to place pipe coils or grids in the floor and pass hot water through the pipes. The pipe runs may, of course, be placed in the walls or ceilings but we have come to feel that the floor type system is the first choice with the ceiling coil in the position of second choice and wall coils only in a supplementary capacity to either of these. For this reason, I shall confine my comments to the floor type system.

In the structural sense the floor type Radiant Heating system is exactly the same as the conventional forced hot water system except that pipe coils are substituted for radiators. The same boilers, expansion tanks, circulators, etc. are used, and you may safely consider the integration of these elements to be exactly the same for the Radiant Heating system as for the conventional hot water system with which you are all familiar.

Heating Calculations

The matter of calculation for a Radiant Heating system is not as intricate as you might believe. The principles are firmly established and begin, naturally, with an accurate calculation of heat loss from the space under consideration. The "Guide" ("Heating, Ventilating and Air Conditioning Guide," published by the American Society of Heating and Ventilating Engineers) covers this type of calculation very thoroughly and I'm sure that you are all sufficiently familiar with it that no more need be said at this time. The difference in calculation for a conventional system and a Radiant system occurs when you begin the calculation of heat input to balance this loss and here's the fundamental trick: for a conventional system you're used to thinking of output from equipment such as radiators only in terms of losses to air at a given temperature. In a Radiant system, two kinds of losses or output from the warmed surfaces are considered — the losses by radiation to the cooler room surfaces and the loss by convection to the air. It would be a little too cumbersome to go into actual calculations of this type right now but since the "Guide" covers the subject reasonably well I would suggest you refer to that authority.

After calculations have determined the physical characteristics of any particular Radiant Heating system, the next problem is to integrate the pipe coils or grids into the structure being planned. Most of the Radiant systems which have been used in this country have incorporated heating coils in concrete slabs which may or may not be on the ground. The thickness of the slab is of no great consequence since there is ample evidence to prove that the system works equally well with slabs ranging from 3″ to 8″ or 10″. The pipe coils may be either encased within the concrete, in contact with the lower surface, or several inches below, embedded in gravel or crushed stone.

Construction Details

At this point I should like to drop a word of warning about slab construction in connection with ground moisture. As you know, concrete is a relatively porous material which will absorb a considerable amount of water coming from either surface sources or rock formations. For this reason it is important that suitable precautions be taken to insure a dry floor. In any case, it is our recommendation that a 6 or 8 inch course of gravel or crushed stone be placed under the slab, with a water proofing seal included between the two elements in locations where there is any reason to suspect the presence of appreciable water. Of course, good drainage practice such as would normally be followed under and around the foundation of any structure is definitely advised.

The actual pipe runs usually take the form of sinuous coils, or grids, in which a supply manifold concurrently feeds a number of runs which feed into a return manifold. Both types have their individual merits. The sinuous coil is usually less expensive to fabricate and a little easier to design. However, the frictional head developed usually climbs so rapidly with increases in the total length that the range of practical working pressures limit this type of coil to either small structures or small areas of large structures. The grid type coil, although normally requiring a few more welds, embodies better hydraulic and thermal distribution characteristics. The vagaries of individual designs prevent making any broad statements as to the relative merits of the two coils but it would be safe to say that the grid type coil is generally adaptable to large structures and the sinuous coil to small ones.

Heat Losses

The question of insulation against downward heat flow from pipe coils

placed on or near the ground is not as serious as many people believe. It is not quite possible to determine the exact amount of this loss but some general calculations can be made. These indicate that approximately 30% of the total heat input will be dissipated to the ground in uninsulated installations while a figure of 20% is fairly accurate for cases in which insulation is used. This may seem a little high at first glance but the percentages are based on a total heat loss for the room or structure which does not include any heat losses downward. This factor would greatly reduce the percentages just mentioned when a comparison is made of downward heat losses from the conventionally heated structure. Furthermore, experience tends to indicate that these assumed rates of downward heat loss are very generous and that in actual practice they are much less than the figures I have given you. At any rate, we recommend continuing their use until additional research makes more accurate calculations possible.

Considering this experience, the designer's question of whether to use insulation under the pipes becomes largely a matter of achieving results in keeping with the economic characteristics of the structure.

Structural Design

The matter of venting the pipe coils of a Radiant Heating system seems to be one of personal opinion. Actual installations are about divided between those which incorporate air vents from the pipes and those systems which are vented only at the expansion tank. A great many authorities insist that vents be provided while just as many equally good authorities contend that a low velocity, low temperature, forced system does not require venting at any point except the expansion tank. So far we have heard of only one installation made without vents which seemed to suffer to any degree as a result. This particular installation embodied coils on four different levels — a single closed system in which the highest coil was farthest from the boiler. Apparently an air lock developed because circulation in this highest coil was resumed as soon as a vent was tapped into the high spot.

Present practice seems to be to lay coils or grids level and depend on the action of a circulator for drainage. My own opinion is that a level coil can be adequately drained by means of a circulator and that this procedure is superior because it automatically eliminates the structural and thermal problems inherent in sloped systems.

Fig. 3: This shows a typical radiant heating installation in a two-story house. Coils are imbedded in the floor slab to heat the first story and coils for the second story are positioned on the sub-flooring. Sleepers are then placed between the pipe runs, to which the finished hardwood flooring is nailed. The sleepers are notched to receive the end coils. Note that this house has a wall coil in the bathroom. Lath is applied over the pipe to receive the plaster coats.

While we are on the subject of the circulator it would probably be well to mention that care should be taken to choose a pump of sufficient capacity rather than to resort to the fairly common practice of shaving a few dollars by the use of an undersized pump. Certainly the installation of a pump of the right size would seem to be absolutely necessary in a well-engineered installation.

Among the questions most often asked about floor type systems are, "Doesn't the floor get too hot?" and "Will it work with wood floors or rugs?" The answer to the first question is that a properly designed system will never produce floor surface temperatures above 85° and this temperature—based on the experience of hundreds of installations—is not excessive. As a matter of fact, it is almost impossible to tell where the heat is coming from in a properly designed installation even though floor temperatures do reach 85°. This surface temperature question also bears a relation to the question of floor construction and coverings. However, I believe it is safe to assume—again basing the assumption on the results of a great many installations involving all types of floor construction and coverings—that just about any of the common materials can be used.

The matter of insulation is one which should receive just as much attention in a house having a radiant system as is given to the same problem when a conventional heating system is used. Much as we like to sell pipe, we are ready to admit that there is no economic justification for heating large portions of the great outdoors. Thus, a few dollars worth of insulating materials really constitutes an ounce of prevention and will usually result in a more contented user.

Temperature Control

A somewhat unlooked-for charac-

(Continued on page 52)

As the JOURNAL Sees It

WITH THE END OF THE WAR if not immediately in sight at least reasonably near, it behooves the Gas Industry to make intelligent preparation to meet the problems that the armistice will create.

The chief of all problems, of course, will be to meet the acute competition of other fuels, especially electricity whose output has been increased immeasurably because of the demands of war. Only through being in a state of utter preparedness will gas be in a position to hold its own, and this in the face of whatever developments may come.

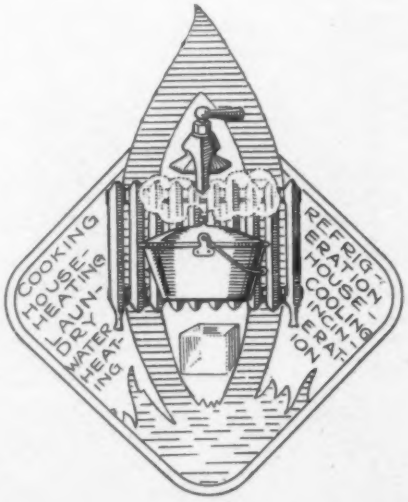
Certainly, there are no tangible reasons why the gas industry should not be able to consolidate the production gains of the past few years, if sound plans for the promotion of the fuel in all spheres where it can be profitably utilized are developed, and of all these fields the most important unquestionably is the domestic load, which accounts each year for approximately 80 per cent of the revenues of manufactured gas companies and 55 per cent of those selling natural gas.

Reduced to its common denominator, increased sales is the gist of post war planning, and it is only through such increased sales that the industry can hope to assume the great industrial load that has been developed through the emergency of war, and go forward also, winning new conquests and giving no ground to its competitors.

It is now that the gas companies must prepare for the after war period. No one is able to predict when the war even in Europe may come to an end. It may come suddenly. On the other hand, the transition may be orderly instead of abrupt. Especially, will this be the case if the war in Europe is indefinitely prolonged, for this will mean such predominance of the Allies in ships, airplanes, guns, and munitions as to permit a gradual resumption of civilian manufacturing that should obviate for the most part the violent repercussions that a sudden armistice might bring.

No single need of the industry today is so urgent than the immediate formulation of comprehensive plans for the post-war sale of gas. These plans should embrace dealer co-operation, radio, billboard, local, and national advertising. It is a known fact that the larger number of sales outlets that were functioning so evenly before Pearl Harbor have been lost to the industry, many of them permanently. Most company sales forces have also been reduced to skeletons of their pre-war consistency. Careful thought and intelligent planning will be needed to restore such promotional agencies to meet the post-war emergency.

Of course, the problems of all companies are not identical. Local conditions are always a factor in utility operation. This means that each company in meeting its own peculiar problems must chart an individual course. However, this does not mean that it should not supplement its own promotional activities by lending its whole-hearted support to the A. G. A. and other organizations who are working unceasingly in the broader national field through the media of advertising, radio, and the lecture platform.



Above all, there must be absolute co-operation between the utility and the manufacturer of gas appliances, through whose efficient operations the very existence of our fuel is dependent. The manufacturers have always been ready and anxious to adopt any constructive suggestions that the gas companies have put forward, and they will be just as willing, no doubt, to co-operate when they are able to resume their normal activities.

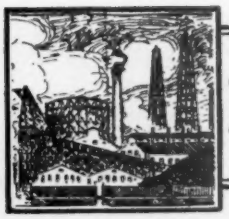
There may be said to be a triumvirate of interest in the gas industry: utility, manufacturer of appliances, and the consumer. Their positions are not identical, but each has a common interest.

This preparation now for greater sales of gas after the war is being undertaken seriously by some gas companies in various parts of the country. The People's Gas Light & Coke Company, of Chicago, has recently completed a survey in which nearly 15,000 housewives replied in detail to an elaborate questionnaire as to their opinions and preferences as to the post-war range. Because of the thoroughness with which it was done and the infinite number of details obtained, its effects should be far-reaching. A thorough analysis of this survey is published in this issue of the *Journal*. It is to be hoped that this company's example may be followed by other utilities, especially by those in cities of smaller population, so that a reliable cross-section of consumer opinion in all parts of the country may be obtained that will serve as an adequate chart for the industry as a whole in its post-war planning.

The JOURNAL takes this opportunity to wish its subscribers, readers, and advertisers a Happy and Prosperous New Year.

S. S. Krake

Publisher



News of the Gas Industry

Southwestern Gas Measurement Short Course June 6 to 8

The Southwestern Gas Measurement Short Course which has been held annually until last year, will be resumed this year. The motion to hold the course in forty-four was given a unanimous approval by the members of the General Committee who attended the fall meeting at Dallas, Texas. The course will be conducted in the main building of the College of Engineering, on the campus of the University of Oklahoma, Norman, Oklahoma. The dates set for the three day session are June 6, 7 and 8.

The omission of the course in 1943 was keenly felt by persons engaged in gas measurement and related work. This was especially true of new personnel who did not have an opportunity to receive the specialized training as given in an intensified form during the Southwestern Gas Measurement Short Course. Older employees also missed the schooling opportunities presented through this educational project.

The General Committee instructed Mr. Earl Kightlinger, Chairman of the Program Committee, to formulate a tentative program to be presented to the group at a meeting which will be held in Oklahoma City in January. It was suggested the morning sessions be devoted to elementary gas laws and the fundamentals of orifice meters, positive meters and regulation. The afternoon sessions, as in the past years, will deal with the fundamentals of regulation giving special attention to round table discussions and the opportunity for field men to receive help on any particular problems they might have.

Various manufacturers will be invited to have exhibits during the school which will be used for the most part as Visual Aids to clarify material covered in lectures. Members of the Armed Services who are charged with the responsibility of gas measurement and distribution at their respective stations will be issued special invitations to attend the course this year.

Detailed announcements relative to this year's Southwestern Gas Measurement Short Course will be released early in March.

Louisiana Engineering Society

The Ninth Annual Meeting of the Louisiana Engineering Society will be held, together with the meetings of the local sections of the National Societies, at the St. Charles Hotel, January 13, 14 and 15, 1944, in New Orleans.

In conjunction with the Meeting, will be held War Production Conferences in cooperation with the War Production Board. Registration will begin at 9:00 A.M., January 13, and the first sessions of the Meeting will begin at 1:30 P.M.

The keynote address of the Meeting will be delivered by Mr. A. B. Paterson, President of New Orleans Public Service, Incorporated, on the subject, "Planning for Louisiana's Post-War Problems."

There will be many technical papers presented at the various sessions.

CONVENTION CALENDAR

January

13–15 *Louisiana Engineering Society,* St. Charles Hotel, New Orleans.

31 to Feb. 2 *American Society of Heating and Ventilating Engineers,* Hotel Pennsylvania, New York City.

March

23 *New England Gas Association,* Annual Meeting, Boston, Hotel Statler.

June

6–8 *Southwestern Gas Measurement Short Course,* University of Oklahoma, Norman, Okla.

Margaret Woodman Andersen Named Grand Rapids' New Home Service Director

Mrs. Margaret Woodman Andersen has been appointed Home Service Director of the Grand Rapids District of Michigan Consolidated Gas Company. She succeeds Miss Lucille M. Hall, who resigned December 15 because of her recent marriage to Mr. Beach Gill of Grand Rapids.

Margaret Woodman Andersen

Mrs. Andersen has been a key member of the Grand Rapids' Home Service Staff for the past five years and is well qualified for her new position. She was graduated from Michigan State College with a Bachelor of Science degree in Home Economics in 1938. Her experience with the Gas Company has included customer contact work in the field, platform demonstration in gas appliances and recently the teaching of Red Cross Nutrition and Canteen Corps classes. Her work has been enthusiastically received by War Service officials, and George Moritz, Director of Civilian War Services of the Office of Civilian Defense, has appointed her Chairman of the Nutrition Committee of the Kent County Defense Council to succeed Miss Hall. Her husband, Corporal Edward H. Andersen, is a dental technician with a Medical Unit in Sicily.

The Gas Company concurrently announced that Lois Nelson Kalawart, Assistant Director, has been assigned additional responsibilities as Supervisor of Nutrition Center located on the first floor of the Gas Company Building.

Miss Lucille M. Hall, Home Service Director for the past six years, was prominent in gas industry home service work, having served on the American Gas Association Home Service Committee for several years and was Chairman of the Mid-West Home Service Committee in 1940. Before coming to Grand Rapids, she was associated with the Home Service Department of the Milwaukee Gas Light Company. She was well-known to the Grand Rapids' radio audience for her "Cooking School of the Air" which she broadcast twice weekly for 638 consecutive programs.

O.W.U. Appoints Joint Task Committee on Manpower

The Office of War Utilities announces the appointment of a Joint Task Committee on manpower to consider the problems of labor shortages and essential manpower supply.

The OWU has expressed the hope that through the Joint Task Committee it can be of real assistance in presenting some of these problems to the other Government agencies involved, and that a policy can be developed that will afford relief in critical instances.

Natural gas representatives on the Joint Task Committee are J. M. Herrmann, The Peoples Gas Light and Coke Company; F. M. Banks, Southern California Gas Company; J. French Robinson, The East Ohio Gas Company, and E. V. Kesinger, Natural Gas Pipe Line Company of America.

Manufactured gas representatives are Ernest R. Acker, Central Hudson Gas & Electric Corp.; Norman B. Bertolette, Hartford Gas Company; Mrs. Helen S. Steers, Brooklyn Borough Gas Company, and James D. Dingwell, Jr., Washington Gas Light Company.

Fuel Efficiency Program of Bureau of Mines

Nearly 4,000 engineers have volunteered for service in behalf of the Bureau of Mines' fuel efficiency program and new enlistments are pouring in daily, Secretary of the Interior Harold L. Ickes announced recently.

Designed to minimize wasteful practices in the use of coal, coke, wood, petroleum, and gas as a part of the Government's critical resources conservation campaign, the program is being organized by a recently-appointed National Fuel Efficiency Council with the cooperation of the Bureau of Mines.

Several coordinators already have been appointed to direct the work of the volunteer regional engineers in the various cities. Dr. R. R. Sayers, Director of the Bureau of Mines, informed Secretary Ickes that coordinators already named include Melvin P. Hatcher, Director of the Water Department, for Kansas City, Missouri; Henry Hebley, Director of Research, Pittsburgh Coal Company, for Pittsburgh, Pennsylvania; J. H. Herron, President of the James H. Herron Engineering Company, for Cleveland, Ohio, and H. K. Kugel, Chief Engineer, Smoke Regulation and Boiler Inspection, for the District of Columbia.

As the larger fuel users have the greatest opportunities for economies, the program first will be directed toward industrial and commercial plants. Regional engineers will ask each company whose plant they visit to enroll in the program and sign a pledge to cooperate by considering fuel-saving recommendations applicable to its operations. The recommendations will be drawn up following a survey of the plant by the regional engineer and a representative of the company to be designated "waste chaser." Other regional engineers, specialists in fuel utilization problems, will follow up the first visit to offer further assistance and to obtain a record of improvements so that possible merit awards may be made where warranted.

Invaluable fuel-efficiency information acquired through years of research by the Bureau of Mines will be made available in addition to the "on the spot" recommendations of competent regional engineers who will serve without pay.

The National Fuel Efficiency Council of 12 engineers outstanding in the field of fuel utilization, has enlisted the cooperation of national engineering societies and many manufacturers of fuel-burning and control equipment through its chairman, Thos. C. Cheasley, Bureau of Mines supervising engineer.

Later, the committee plans to expand its program to include small consumers, home owners, and others.

Baxter Heads Arkansas Western Gas

L. L. Baxter, of Fayetteville, Arkansas, vice president of the Arkansas Western Gas Company since 1936, has been named president.

L. L. Baxter

His selection was announced following the setting up by the company of a new board of directors in compliance with an SEC order. Other members of the board of directors are: Clint Murchison, of Dallas, Texas, chairman; John Cain, also of Dallas, E. W. Cook, of El Paso, Texas, and Marion Wasson, of Fayetteville, Arkansas.

Mr. Baxter came to Fayetteville from Dallas in 1932 as district manager and since has been prominently identified with various civic and public affairs. At the present time, he is Secretary-Treasurer of the Southern Gas Association.

Heating Engineers To Commemorate Fiftieth Anniversary

Decisions of far-reaching importance will be made at the 50th Annual Meeting of the American Society of Heating and Ventilating Engineers scheduled for January 31, February 1 and 2, 1944, at Hotel Pennsylvania, New York.

A Business Session will be opened by President M. F. Blankin on Monday, January 31, and the Greetings and Anniversary Messages received from various organizations will be presented, as well as the Annual Reports of Officers and Committees.

Following the Business Session there will be five Technical Sessions and papers will cover a wide range of subjects, all relating to The Past, The Present and The Future of Heating, Ventilating and Air Conditioning.

While the Society commemorates its 50th Anniversary, it is of interest to note that 1944 also marks the 25th Anniversary of the establishment of the Society's Research Laboratory. During this period of time the ASHVE Laboratory has studied a great variety of subjects, has established an enviable record in preparing technical data for the solution of engineering problems.

Customary Year-End Incentive Payments For High Production Distributed by the Lincoln Electric Company, Cleveland, O.

Saying that he refuses "to renegotiate his own workers," despite renegotiation proceedings now pending between his company and the Navy Department, J. F. Lincoln, President of The Lincoln Electric Company, early in December, announced the distribution of the year-end pay averaging over $2250 per employee. The payments were computed on the same basis as that of the previous ten years in which the earnings of the man, combined with his years of service and his development, gauged the amount of money he received.

These year-end checks which were distributed at the plant ranged from $25 in the case of a newcomer, to $50,000 in the case of an engineer, whose genius produced a new type of welder which cut the cost of production by nearly 50 per cent.

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American Gas Association Activities

Finance and Control Committee

The following members of the Finance and Control Committee of the American Gas Association have been re-elected by the Association's Executive Board: James A. Brown, Commonwealth & Southern Corp., New York, chairman; George S. Hawley, president, Bridgeport Gas Light Co., Bridgeport, Conn.; Frank H. Lerch, Jr., president, Gas Companies, Inc., New York; and P. S. Young, chairman of Executive Committee, Public Service Electric & Gas Co., Newark, N. J.

After constitutional amendments have been adopted, the two vice-presidents of the Association will also be members ex-officio.

Committee on Coordination of Research

Upon recommendation of the Special Committee on Organizational Changes, the Executive Board of the American Gas Association has authorized the creation of a Committee on Coordination of Research to be appointed by the President and to include the chairmen of A.G.A. research committees.

The function of the committee will be to maintain a constant review of all Association research and to make recommendations to the Executive Board regarding all research undertakings. It will be especially charged with the responsibility of making recommendations on the relative importance of research items to the Finance and Control Committee prior to preparation of the annual budget estimate.

Departments and Sections of the Association will be requested to contribute to the work of this committee.

At the same meeting of the Executive Board, it was voted to continue the Special Committee on Organizational Changes during the present Association year, with the following membership: J. French Robinson, Chairman, Ernest R. Acker, Arthur F. Bridge and George S. Hawley.

Feltes Elected to Executive Board

N. R. Feltes, vice-president of Bastian-Morley Company, Inc., La Porte, Indiana, has been elected to the Executive Board of the American Gas Association. He fills a vacancy caused by the resignation of Watson E. Derwent, who recently retired as vice-president of George D. Roper Corp.

Mr. Feltes has been executive vice-president and director of Bastian-Morley Co., Inc., since 1933. He was president and director of N. R. Feltes & Co., Chicago, from 1928 to 1933 and for ten years previous had been treasurer and director of the Studebaker Corp., South Bend, Ind. Prior to that time he had been associated successively with Morgan & Wright, Detroit, a U. S. Rubber subsidiary; Losier Motor Co., Detroit; and Ames Holden McCready, Montreal shoe manufacturers.

He has been active in the Association of Gas Appliance and Equipment Manufacturers, serving for two years as a director and as chairman of the Policy Committee. He is now serving as a director of the Plumbing and Heating Industries Bureau, Chicago.

Mr. Feltes has been president of American Trust Co., South Bend, since 1935; director of Electric Spraylit Co., Sheboygan, Wisc., since 1928, and director of Campbell, Wyant and Cannon Foundry Co., Muskegon, Mich., since 1942.

Technical Conference On Domestic Gas Research

On Thursday and Friday, February 17 and 18, there will be held in Cleveland, Ohio, an important gathering of engineering and other technical men from appliance and related equipment manufacturing companies, which will be known as American Gas Association Technical Conference on Domestic Gas Research, according to an announcement of Everett J. Boothby, Chairman, Committee on Domestic Gas Research. This will be an entirely new type of engineering conference within the gas industry, and was authorized by the Executive Board of the American Gas Association in order that the accumulation of fundamental research, both published and unpublished, can be presented and analyzed to help speed its application toward producing better gas appliances in the future.

The program of fundamental research conducted by the American Gas Association is an extensive one and, through the action and support of the Executive Board, has been greatly expanded during 1943. It is being still further expanded during 1944. The accumulation of technical material resulting from work done at the A.G.A. Laboratories is now the greatest of any time since the program began and ten technical bulletins have been published. The designers and other technicians of appliance manufacturing companies working with the Laboratories staff and members of the Technical Advisory Committees will, at this Conference, be able to bring themselves entirely up to date on the fundamental research that has been done and is now being done in combustion, heat distribution, ignition, venting, heat losses, speed, and related subjects.

Only subjects pertaining to the technical phases of domestic gas research will be considered at the Conference which will be held at Hotel Statler, with demonstrations at A.G.A. Testing Laboratories.

All manufacturers of gas appliances and related equipment will receive an invitation from the Committee on Domestic Gas Research to have their chief technical man in attendance, together with such technical assistants as they may designate. Officials of companies will also be in attendance as will interested technical men from gas utilities.

In order that West Coast manufacturers and utility engineers will be able to take full advantage of the fundamental domestic gas research that the American Gas Association has carried on the Research Conference will be repeated on the Coast about a month after the Conference in Cleveland, at a time and place to be announced.

War Conference On Industrial and Commercial Gas

Announcement has been made by Mr. Charles G. Young, Chairman of the Industrial and Commercial Gas Section, that by action of the Executive Board the 1944 American Gas Association War Conference on Industrial and Commercial Gas will be held at Hotel Seneca, Rochester, N. Y., Thursday and Friday, March 30 and 31. This Conference, which was held in Detroit last Spring, is the year's outstanding gathering of industrial and commercial gas men and equipment manufacturers.

The handling of many problems that have arisen in applying industrial gas to higher speed, higher quality and greater quantity production in war plants is now teaching industrial gas men valuable lessons. Many of these lessons will be analyzed thoroughly and discussed at the Conference and interpreted in terms of better industrial gas utilization in the future. Also, lessons being learned from the operation of commercial cooking and baking equipment under the terrific strains imposed by war-time operations in public eating places will receive close attention.

Post-war plans, as they are developing in the industrial and commercial gas fields, will be featured at the Rochester Conference. The handling of problems concerning natural, manufactured and mixed gases will make this event of value to representatives of every gas company and every appliance and equipment manufacturer.

Ivar Lundgaard, Manager of Industrial and Commercial Gas Operations in Rochester, has been appointed by Mr. Young to head up the Program Committee. All members of the Managing Committee of the Industrial and Commercial Gas Section are now reviewing subjects and features for the Conference. Their recommendations will be the basis for the final program, which will be prepared by Mr. Lundgaard's Committee, thus assuring that the Conference will cover subjects of interest to all.

The Managing Committee has voted to hold its next meeting in Rochester the day prior to the Conference.

P.C.G.A. Organizes For Post-War Planning

Many compliments have been paid Mr. H. L. Masser for his comprehensive report to the Annual Meeting on the post-war problems of the gas industry. The matter has not rested there, however. A meeting of the Committee for Gas Industry Development was held in Los Angeles on October 13 and definite assignments of studies were made.

The Sales and Advertising Section, R. J. Phillips, Chairman, was asked to study the post-war market based on records of the past, but taking into account new developments such as West Coast population gains, possible industrialization, housing needs and characteristics and probable competitive conditions.

The Post-War Appliance Committee, W. M. Jacobs, Chairman, was asked to continue its study of appliance improvement. At a meeting of this committee on December 8, two sub-committees were formed. The first, headed by Frank Weiss, Southern California Gas Company, will investigate the possibilities of new appliances such as dishwashers, incinerators, etc., and the second headed by E. H. Adler, San Diego Gas and Electric Company, will devote itself to commercial and industrial appliances. The Post-War Appliance Committee late in November mailed to all Pacific Coast manufacturers a comprehensive outline of possible fields for research in the development of domestic gas appliances. Copies of this outline have been requested by A.G.A.E.M. for distribution nationally.

The study of post-war sales policies, including advertising and sales financing, was assigned to a special sub-committee headed by O. R. Doerr, Pacific Gas and Electric Company. The possibility of more uniformity in utility sales and service policies will be considered as an aid to manufacturers and distributors.

To the Technical Section, Elting Henderson, Chairman, was assigned an investigation of new materials, of construction, training of service and operating personnel and a study of the Pacific Coast gas supply situation, both natural and manufactured.

Mr. W. G. Vincent, Pacific Gas and Electric Company, a member of the main committee, has undertaken a study of national economic factors as they may affect the post-war gas business on the Coast. Among these are manpower and employment possibilities. In this Mr. Vincent has asked R. R. Blackburn, Southern California Gas Company, to enlist the aid of Pacific Coast personnel men and as a result Mr. Blackburn has called a personnel meeting to be held in San Francisco on January 19 and 20.

The Manufacturers Section, A. H. Sutton, Chairman, will work closely with all these projects, particularly in furnishing statistical material and in advising on appliance production possibilities.

OTTO GOLDKAMP

In the death Dec. 23rd at Mercy Hospital of Otto Goldkamp, gas meter department superintendent for the San Diego Gas and Electric Company, the nation's gas industry lost one of its ablest, most original and inventive meter men. His inventions in the fields of gas pressure regulation, and in the accurate measurement of gas flow gained for him an international reputation. His ideas were always extremely practical and his work shop was visited by prominent gas technicians from all over the country.

In 1937 Mr. Goldkamp was awarded the Pacific Coast Gas Association's Basford Trophy for outstanding achievement, a recognition few individuals have been accorded.

All of his devices are used extensively in the meters and distribution system of the local gas utility as well as throughout the entire United States. They include a variety of appliances for the repairing and testing of gas meters, a combination meter and regulator (the only type of its kind in existence), a compounding regulator for the more constant control of gas pressure in connection with branch feeders from main high pressure transmission lines, as well as several straining devices for the screening of dust particles, thus permitting the free flow of gas to pilot lights and other extremely small burner openings.

Throughout his career Mr. Goldkamp was active in the work of the Pacific Coast Gas Association, having served on various technical committees and for one year as chairman of the association's Technical Section. Business in general profited from his research in the field of leather tanning, a study he pursued in the connection with improving the method of treating meter diaphragms.

Born in San Diego February 21, 1894, Mr. Goldkamp was a member of the famous East End Gang. He had been in the employ of the local gas and electric company since 1909, advancing from messenger to meter reader to foreman of the gas meter repair shop and finally to Superintendent of the gas meter department, the position he held at his death.

JOHN MANLEY FISHER

John M. Fisher, Regional Manager for the Bryant Heater Company, died at St. Luke's Hospital, Cleveland, on December 14th. He was better known to his friends and associates as "Cap" Fisher.

Very few men have had such a colorful and interesting career. Canadian born, he enlisted in the Canadian Army at the outbreak of World War I, served three years in France, and then joined the British Secret Service when volunteers were requested to undertake a dangerous mission in the Middle East. This led to a series of interesting and important adventures in Mesopotamia similar to the exploits of Lawrence in Arabia.

Mr. Fisher attained the rank of Major and received many decorations as a reward for his accomplishments and bravery.

After the war, he spent several years with the Anglo-Persian Oil Company in Persia and India, engaged in drilling operations in Mexico, then entered the gas heating business in 1926.

In 1933 he joined The Bryant Air Conditioning Corporation, Chicago, and came to Cleveland in 1939 as Regional Manager for The Bryant Heater Company. He became very well known throughout the Gas Industry as an able and most interesting man.

A. E. LINDQUIST

Albert E. Lindquist, publisher of *Gas Age* and secretary of the Robbins Publishing Co., died unexpectedly following a heart attack Sunday morning, December 5, at his home in Chappaqua, N. Y. He would have observed his 51st birthday on December 15, and had been with the Robbins publications for 22 years.

Born in Boston, Mr. Lindquist graduated in 1916 from Massachusetts Agricultural School, now Massachusetts State College, Amherst. He was associate editor of *Better Farming*, 1916-17, and a special assistant for the U. S. Department of Agriculture, 1917-18. He served as lieutenant of infantry in the U. S. Army.

Mr. Lindquist then joined the advertising staff of the *Daily Times* in Ranger, Texas, and later became western editor for the Soil Improvement Committee. He was advertising representative in the Pittsburgh territory for *Gas Record*, and became middle western manager when *Gas Age* and *Gas Record* were merged in 1921, making his headquarters in Cleveland. He came to New York as advertising manager of *Gas Age-Record* in 1928, and later became publisher of this magazine.

Mr. Lindquist was clerk of the Gild of Ancient Supplers and commander of the American Legion Post No. 453, Chappaqua.

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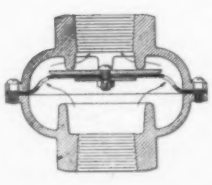

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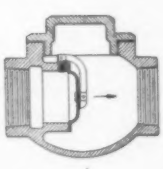

NORWALK VALVE COMPANY

85 Spring St. South Norwalk, Conn.

H. J. Rust, Sales Manager Handley Brown Heater Co.

Harold J. Rust, formerly Director of Sales of Acme Industries, Incorporated, Jackson, Michigan, has been appointed Sales Manager of Handley Brown Heater Company of Jackson, Michigan, reports Harold E. Handley, General Manager of the Company.

Harold J. Rust

In 1927, Mr. Rust started with Consumers Power Company of Michigan in the Saginaw Division as Crew Manager of Water Heater Salesmen. He was made Appliance Superintendent of the Saginaw Division in 1928 and came to Jackson in 1934, assuming the duties of Gas and Electric Appliance Sales Superintendent.

Serving sixteen years in the Appliance Field with utility operations, Mr. Rust directed sales of all types of appliances, including service and advertising.

Pemco-Nordstrom Offices Opened in Atlanta, Ga.

New offices of Pittsburgh Equitable Meter Company-Merco Nordstrom Valve Company have been opened in Atlanta, Georgia. C. C. Moore, who has been in charge of our Memphis office, is District Manager. The offices are located at 411 Bona Allen Building, Spring and Luckie Streets. The Memphis office will be closed at the end of December, so that all southern operations formerly cleared through Memphis will now be handled through Atlanta.

The McCarty Company of Los Angeles Opens Pittsburgh Pa. Offices

R. S. Reed Jr.

Establishment of new offices in Pittsburgh, opened January third, is announced by The McCarty Company, industrial advertising counsellors. This expansion is in keeping with the company's conviction that great post war activity will center around Pittsburgh.

R. S. Reed, Jr., for the past twelve years advertising director of Pittsburgh Equitable Meter Company, Pittsburgh, and Merco Nordstrom Valve Company of Pittsburgh has been appointed manager of the Pittsburgh office. The McCarty Company has handled the advertising of the Nordstrom concern for twenty-two years through its Los Angeles and San Francisco offices.

Effective January three the Pittsburgh Equitable Meter account will also be serviced by the company's Pittsburgh office, which is located in Suite 2205, Koppers Building.

Jensen Elected Treasurer of Niagara Hudson Corp.

Harry F. Jensen of Ridgefield Park, New Jersey, was elected an assistant treasurer of Niagara Hudson Power Corporation at a December meeting of the board of directors.

Mr. Jensen's association with the company began in July, 1931, and he has been cashier for the past nine years. He was previously employed by F. L. Carlisle & Co., Inc.

George W. Baldwin is New Sales Manager for Roper

George W. Baldwin, an active figure in the Geo. D. Roper Corp., who recently severed his connections with the War Production Board, has been appointed sales manager of the company's gas range division.

Having had a wide experience in various phases of gas range manufacture and selling, "Baldy," as he is popularly known, is well qualified for his new position. Starting with Roper twenty years ago, he progressed through many phases of office and shop control. In 1933 he moved to Washington as the company's sales representative to cover the territory embracing Maryland, Delaware, District of Columbia, Virginia, and part of North Carolina.

When, by government order, Roper discontinued gas range production last year, the WPB selected Baldwin to assist in formulating plans and rulings in connection with the many phases of appliance manufacturing control. He acted as chief of the domestic stove section of the plumbing and heating division of WPB until October of this year.

Bastian-Blessing Appoints New Division Manager

Frank H. Fisher of Chicago has been appointed manager of the Welding & Cutting Division of The Bastian-Blessing Company, 4203 Peterson Avenue, Chicago. He will supervise promotional and sales work of the Company's "Rego" line and work in close cooperation with customers of their welding and cutting products.

Mr. Fisher brings to his new work a rich background of practical experience. He was previously associated with American Steel Foundries of Chicago, and also served for a number of years as district sales manager of R. Cooper, Jr., Inc., General Electric Company's Chicago distributor.

The Reliable Shut-Off for Street Mains

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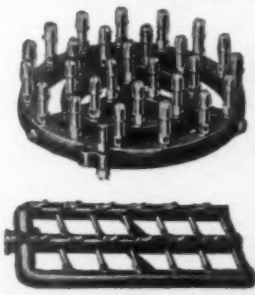
For All Gas Appliances



Under wartime stresses of fuel shortages and material scarcities, the economical, continuous, trouble-free performance of gas appliances, now in operation, equipped with Barber Burners, is an outstanding contribution to the war effort. Our factory is now concentrated on combat equipment. For permitted purposes, our regular line is still supplied. Later, Barber Burners and Regulators will again be available to all.

Latest Catalog on request.

THE BARBER GAS BURNER CO.
3704 Superior Ave. Cleveland, O.

GAS PLANT EQUIPMENT

UGI REFINERY GAS REFORMING PROCESS
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GAS DISTRIBUTION

PIPE LINE CONSTRUCTION

THE U.G.I. CONTRACTING COMPANY
A DIVISION OF
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"Pioneer of the Small Trencher"
20100 ST. CLAIR AVENUE CLEVELAND, OHIO

Cooling System

(Continued from page 18)

Oil Emulsion Thrown Off

After emerging from the generators in the form of vapor, it was passed through a series of wash boxes and scrubbers, and finally sent on to the open-air cooling tower. This tower is of the conventional baffle-board cascade type which cools the product to atmospheric temperature by the time it has reached the bottom of the tower. In the cooling process, an oil emulsion in the form of a small quantity of oil precipitated out with the gas was drawn off by chemical process. A minute portion of this oil, however, became entrained in the water.

The original open-air cooling, tower permitted some of the water to spray into the air, in the course of which a small portion of the odorous oil emulsion also passed into the air, causing the "fume" difficulties.

In the new cooling system, the vapors are taken from the scrubbers and passed through the copper tubes in the heat exchangers, while the cooling water, enclosed by the shell of the unit, passes around the outside of the tubes. In the present system none of the water used for cooling the gas vapors contacts the atmosphere, thus entirely eliminating the spraying of water and oil emulsion into the air.

Fume Trouble Eliminated

The new system is reported by the gas company to have entirely eliminated the distribution of fumes. The original cooling tower will be used to cool the oily water from the scrubbers and the clear water which performs the cooling in the heat exchangers. In neither of these operations is the water polluted by other matter that could produce noxious odors.

The gas company has steadily maintained that the butadiene plant was not the sole contributor to the fume situation, but that the condition was the result of the combined operations of all the industrial plants in the area in which the butadiene plant is situated, plus exhaust gasses from automobiles.

On November 17, while the butadiene plant was shut down for installation of the new heat exchangers, the company had the satisfaction of seeing this theory vindicated. The butadiene plant was inoperative but the eyes of the public were still irritated by fumes.

Radiant Heating

(Continued from page 44)

teristic of radiant heated space is that air temperatures closely follow the mean radiant temperature. This means that the ordinary room thermostat will provide a thoroughly suitable means of control. In most systems, thermostats of this type are wired to the circulator and close observation adequately proves this control scheme to be satisfactory. As a matter of fact, control design in a Radiant Heating system is subject to exactly the same latitude that is available for the conventional forced hot water system. Such devices as boiler water aquastats, anticipating thermostats, mixer valves, etc., will add just as much to a radiant system as they will to any other but their use is no more necessary than is normally the case.

Installation Costs

It has been rather difficult to get actual dollars-and-cents "first costs" on a comparative basis for obvious reasons. Once any type of system is installed in a given structure, the comparative cost of any other system for that same structure can be based only on necessarily inexact estimates. In this connection, radiant heating estimates are sometimes deceptive due to inexperience on the part of the contractor or fabricator who fears that he is getting into something deep, dark, and mysterious, and therefore leaves a very comfortable pad to protect him. For example, we have on our records the case of a house recently built in Illinois in which the architects wanted to use radiant heating. They collaborated with a local engineer, worked out a suitable system and then submitted it to a heating contractor for a bid. He flatly refused to have anything to do with such quackery so the architects said, "All right, we'll be our own heating contractors." They proposed to use a sinuous coil and, to have this work done, they asked a number of local fabricators to submit bids for the pipe bending. As a result, the lowest quotation they got was $1.50 per bend of 1½" pipe. They felt this was a little on the high side and decided to do the bending themselves on a homemade jig. For their own records they made an accurate time-study and found that they averaged five minutes per bend from the time they took a length of pipe from the stock pile, measured it, bent it, took it into the house, and returned for another length.

Perhaps the best index to the installed cost of a radiant heating system can be had from a comparison of the costs of actual complete installations with the total cost of the structures involved. This provides a figure which in turn can be compared with the same cost ratio for conventional systems. On this basis, it has been our experience that radiant heating systems will average from 6 to 10 per cent of the total cost of the structure. Consider these three examples, all 6-room houses:

House #1 cost $8,000 of which the radiant heating system accounted for 6.8%
House #2 cost $6,500, the heating system accounting for 7.5%
House #3 cost $5,200, with 9.6% going into the heating system.

As you know, these figures compare favorably with any good conventional system.

Of course it goes without saying that when comparing the cost of any two heating systems care should be taken to see that the comparison is made on an equal basis. Where such refinements as zone control, anticipating thermostats, aquastats, etc., are involved, they should be either allowed for or included in all systems being studied.

Operating Costs

Comparative operating costs have also been a little hard to pin down but we have developed considerable data to indicate that measurable economy, in some cases as much as from 15 to 30 per cent, can be expected. I won't go into this point in any detail at this time but as brief evidence of the validity of my opinion a number of people with oil burning radiant systems in the tightly rationed East have told us that they were able to get through last winter very comfortably and in some cases with a sizeable margin to spare. A number of people have also sent us a record of their gas bills, and we find these to be remarkably reasonable when based either on dollars or heat units.

Flexible Metallic Tubing. Titeflex Metal Hose Co., Newark, N. J., has issued catalogue, #113, which deals with the general industrial applications of their line of flexible metallic tubing. This catalogue describes their types of tubing used in the conveyance of oils, gases, and liquids. Complete data is given on available fittings, both industrial and S.A.E. Also included are complete pressure charts, charts showing radius of bend, and much other essential data.

"Here's the FIRST THING we'll buy when Daddy comes marching home"

● First on your customers' buying lists after this war will be a new Gas Range. Every woman will tell you! Every market study proves it! And first on your customers' Range lists will be a CP Gas Range.

Gas Ranges bearing the CP Seal are the American woman's buying guide — the standard by which all other cooking appliances are judged. For these are the Gas Ranges that revolutionized cooking and gave women a new conception of time, food and money-saving cooking perfection. That's why, when the war is over, CP Gas Ranges again will pave the way for better business for you and greater sales of Gas — the ideal fuel.

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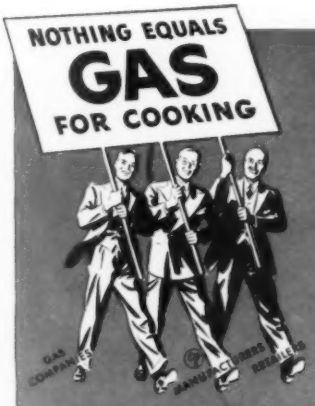
In more than 20 million newspaper advertisements, gas utilities from coast-to-coast are urging American women to *Buy War Bonds Today for the CP Gas Range You Will Want Tomorrow* — helping keep Gas the Preferred Cooking fuel in the homes of 85 million Americans.



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THE ESTATE STOVE CO.
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CP *The Gas Range of Tomorrow*

Gas Register FOR THE INDUSTRY

Gas is accounted for when Sprague Meters are on the job. At this time, Gas is a precious commodity and its volume of consumption at its greatest peak. No one is short changed when it is measured accurately and economically through a Sprague Gas Register.

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